The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

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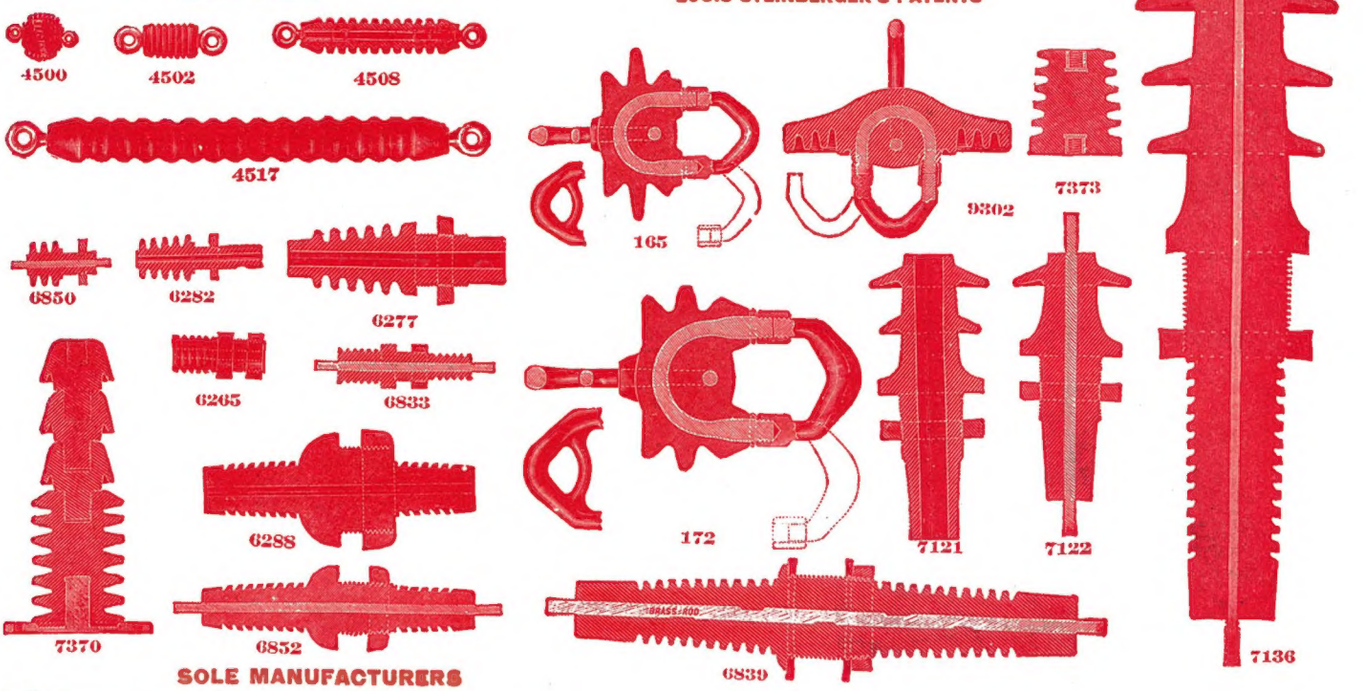

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AMERICA

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will both vibrate when one of them is struck. This same principle has been applied to Brandes Wireless Receivers. By perfectly matching the tone of the two receivers, the weak sounds that you would otherwise lose, are brought out so as to be easily interpreted.

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They are very light and easily adjustable. No pinching or slipping. You set them to fit exactly; after that they're as easy on your head as your hat.

"Superior" Set. Price $5.00 complete, including headband

Our Catalog E contains some very valuable information about radio receivers, as well as a full explanation of several types of Brandes head sets. Send 4c. in stamps for your copy to-day.

C. BRANDES, Inc.

Wireless Receiver Specialists — Room 814, 32 Union Square, New York

Brandes Wireless Head Sets

NEW PRICES

Effective January 15, 1916.
All previous prices void.

Switch Contact Points

We are in a position to furnish prompt shipment of the following sizes of switch points:

Tapped to take 6-32 screw.

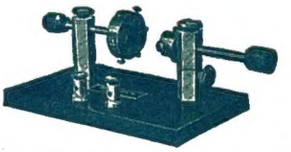
No.	Diam.	Height	Doz.	50	100
626..	¼ inch	⅜ inch	$.30	$1.00	$1.75
628..	¼ inch	¼ inch	.30	.90	1.50

With ½ inch shank threaded 6-32

627..	¼ inch	¼ inch	$.36	$1.25	$2.00

Nickel points 50 per cent. advance.
Postage extra.

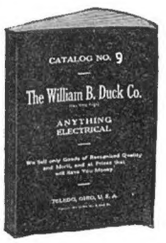
The "Albany" Combination Detector



Lacquered brass.....$2.50
Polished nickel..... 3.00
Postage extra—Weight 1 lb.

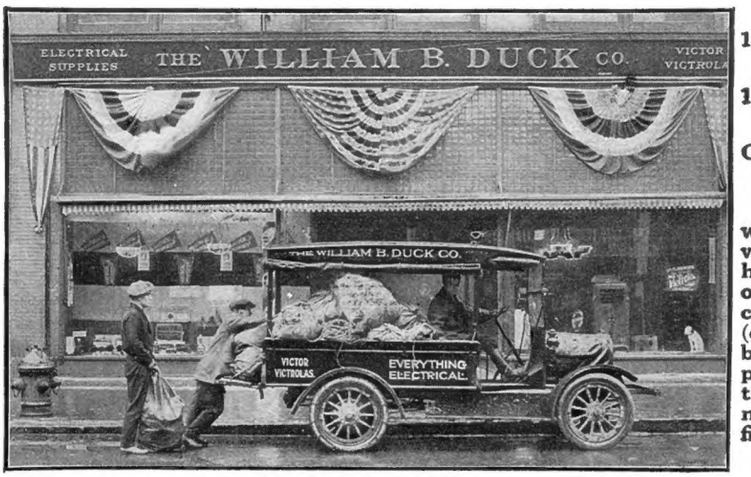
MAGUIRE & SHOTTON
814 LANCASTER ST.
ALBANY, N. Y.

DUCK'S NEW BIG No. 9 320-PAGE ELECTRICAL and WIRELESS CATALOG



MORE THAN EVER JUSTIFIES YOUR VERDICT
THAT IT IS THE *ONE* CATALOG WORTH WHILE

15,000 of our catalogs ready for delivery to eager electrical and wireless enthusiasts in all parts of the world. One of ten consecutive shipments of catalogs to our patrons during last November.



150 pp. Wireless Instruments.

170 pp. Electrical Supplies.

Over 40 pp. of Wireless Instruments.

Only 8c. in stamps will bring this unrivalled catalog to your home. The great cost of catalog and the exceptionally low prices (oftentimes fully 25% below usual retail price) prohibits its distribution otherwise. You may deduct the 8c. on first $1.00 purchase.

WHAT OUR BIG CATALOG CONTAINS

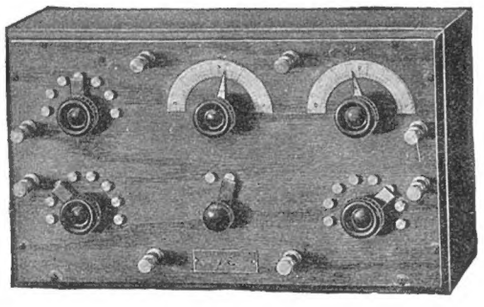
150 pp. Wireless Instruments, magnet wire of all kinds, raw material, storage batteries, telegraph instruments, battery motors, commercial motors and generators, sewing machine motors, telephones, step-down transformers, massage vibrators, bells, push buttons, auto accessories, flash lights, hand lanterns, auto and miniature lamps, Xmas tree outfits, voltmeters, ammeters, lighting plants, Victrolas, air rifles, electric aeroplanes, model builders, electric railways, electrical and mechanical books and general electrical supplies.

The William B. Duck Co., 230-232 SUPERIOR ST. TOLEDO, OHIO

NEW VARIOMETER

A De Luxe Wireless Receiving Station

Wave Length 3,000 Meters — On An Average Length Antenna



DE LUXE improved variometer a complete Station to receive N. A. A. Arlington, Va., N. A. R. Key West, Fla., W. S. T. Miami, Florida, capable of receiving all government or commercial Stations along the coast, and has a wave length of 3,000 meters on an average antenna.

The Station consists of variometer tuner working on entirely new principles, different from any heretofore offered. It consists of a primary and secondary loading inductance placed in non-inductive relation to each other. The Tapped Loading Inductance does the tuning by means of units and tens switches, which produce the most efficient tuning.

A Short wave variable condenser is placed in across with the antenna so as to enable you to work the amateurs at leisure, another variable is placed across the secondary by means of which the capacity of the secondary circuit is raised to a higher wave length. In this set is placed a new Instant Radiograph in place of a detector which will enable you to receive signals instantly at all times without loss of time or messages.

This Station is set into a mahogany finished cabinet and hard rubber top, complete with 2,000 Ohm Brandes Superior Head-set, at our lowest possible price, $20.00 for March. This outfit is well worth $50.00 to you.

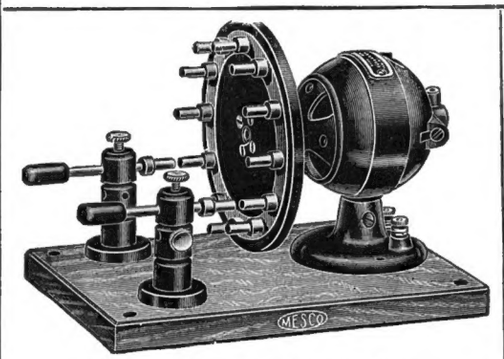
Send 6c. Stamps for 156 Page Wireless Catalog

You need this new book, "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.

NICHOLS ELECTRIC CO. 1-3 West Broadway, New York

"QUALITY" is our Wireless Watchword

SATISFACTION GUARANTEED OR MONEY REFUNDED OUR MOTTO



Mesco Rotary Spark Gap

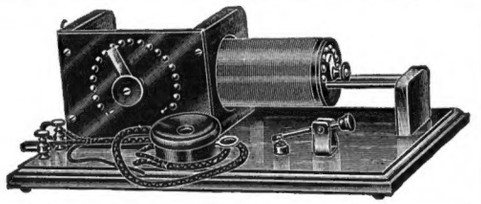
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes for 3/16 in. shaft	5.00

Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	Manhattan Wireless Receiving Set	$10.00

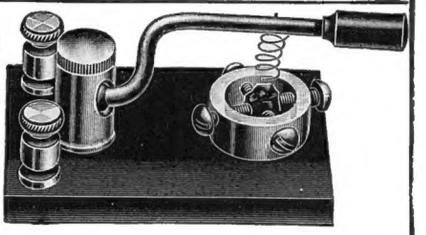
Mesco Intensifying Transformer

Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

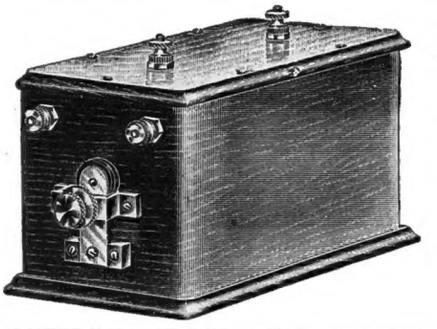
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

Get the Best 10c. Value You Will Ever Buy

SEND FOR OUR POCKET CATALOG, W 28

It contains 248 pages, 1,100 illustrations and costs you nothing.

IT MEANS MONEY SAVED TO YOU

to have our Manual and our Catalog when you want to buy.

Mesco Codegraph

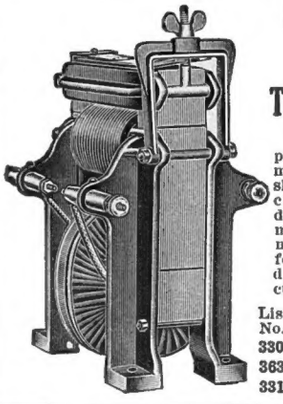
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	Mesco Codegraph Set	$2.50
304	Codegraph Plate, Pen and Book	1.00

MANHATTAN ELECTRICAL SUPPLY CO.

New York, 17 Park Place. Chicago, 114 S. 5th Ave. St. Louis, 1106 Pine St.
San Francisco Office, 604 Mission St.



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Price.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

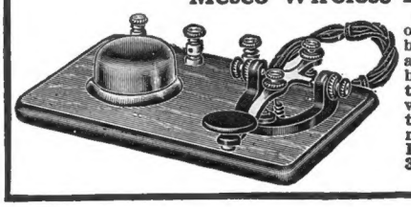
Mesco Wireless Receivers

Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 1000 ohms each	$6.00

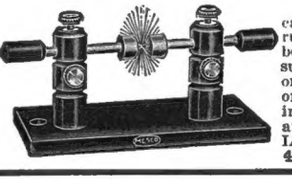
Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.38

Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$2.80

The Electrical Experimenter

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The Future of Wireless

AT the present state of the art, Wireless can be sub-divided into three classes:

1st. Wireless Telegraphy or Radiotelegraphy.
2nd. Wireless Telephony or Radiotelephony.
3rd. Wireless transmission of Power. The latter we may term as *Radiokinetics.*

As is well known, the first two are already in every-day use, all over the world. The third is as yet undeveloped, but already it looms large above the horizon.

Like all great things, Wireless has had its share of trials and tribulations. It takes time to develop an entirely new art. Moreover, Wireless received a black eye in its earliest infancy in this country. As will be recalled, a number of unscrupulous individuals unloaded millions of dollars of worthless stock on a credulous public, before the art had sufficiently advanced to make possible a successful commercial exploitation.

Practical commercial Wireless Telegraphy is not much older than ten years to-day. Commercial Radiotelephony has but made its appearance during the past one or two years, while Radiokinetics does not exist at all as yet.

But let us consider how the three classes of Wireless line up as far as their ultimate usefulness and commercial practicability are concerned. Let us look the problem square in the face and let us see what we shall find.

It is our opinion that a purely Wireless Telegraph Company can never reach such immense proportions as our wire telegraph companies. The reason is obvious. The wire telegraph companies are too well intrenched to be driven out of the field; it is quite certain that wireless telegraphy can no more hope to supersede wire telegraphy, than the telephone superseded the wire telegraph. Aside from this it seems hopeless for any one large central wireless plant to send out and receive within a single hour, 8,366 separate messages, as is the case for instance with one of the New York offices of the Western Union Telegraph Company. Wireless will probably never lend itself to such exploitation. Its greatest use will always be long distance transmission of intelligence, either over land or water or both, and between land and ship or vice versa, or between ships. This is its true field and here the wire companies cannot compete. This naturally limits its possibilities. Thus, while the future of Wireless telegraphy does not seem too rosy, we need not feel discouraged. The young man who embarks in radiotelegraphy to-day, will use it only as a stepping stone towards something infinitely greater. This was the exact case of E. N. Vail, the present head of the American Telephone and Telegraph Co., popularly known as the Telephone Trust. Vail was originally a telegraph man when he was called in by Bell and his associates; had he not known all about telegraphy he probably would not be the president of the huge corporation to-day.

This brings us to Radiotelephony. To us there does not seem one field in the entire electrical industry that is destined to a greater and speedier development than this one. We venture to say that within the next fifteen years, Radiotelephony will become one of the greatest electrical industries, for it supplies one of the predominating wants of the times.

The radiotelephone can be used by anyone, just as easily as the wire phone. To operate the instrument it is only necessary to take down the receiver and talk. But three months ago it was demonstrated that it is eminently practical to catch the wireless voice—on the wing as it were—and connect it with an existing wire telephone line. Vice versa, President Vail talked into a wire telephone at New York, where his voice was transmitted to Arlington; here it "took wings" and was wafted without wires to Honolulu, some 4,000 miles distant. This accomplishment more than anything else has opened the public's eyes.

We prophesy that in less than 15 years every automobile, whether pleasure or commercial, will carry its small radiophone outfit. Its occupants will thus be in constant touch with their homes or offices and vice versa, a convenience much needed to-day. Imagine the immense usefulness of such a device. Nor is this an idle dream. There is at least one company in existence to-day capable of filling an order to equip autos with radiophones having a 20 mile range. Nor will there be much confusion of voices becoming mixed up in transit; our tuning apparatus is becoming more accurate each day and it will be an easy matter to tune out unwanted voices. It will take considerable capital and a host of trained men to turn out enough radiophones to equip several million automobiles, aeroplanes, motorboats, yachts, and large vessels, but it will be done nevertheless and soon at that. Every farmer will have his Wireless Telephone to talk with his neighbors. Every train will have its radiophone enabling passengers to talk to their homes or offices. The radiophone will link moving humanity with the stationary one, the same as the wire telephone linked humanity together before. To us there is nowhere a brighter future than in the vast possibilities of the Radiophone.

As to Radiokinetics, this will surely follow the Radiotelephone in due time. Its future is probably even brighter than the latter. Already Tesla speaks of transmitting energy by the thousands of horsepower wirelessly. Who dares predict what this branch of wireless will bring during the next twenty years?

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. ***A green wrapper indicates expiration.***

All communications and contributions to this journal should be addressed to: Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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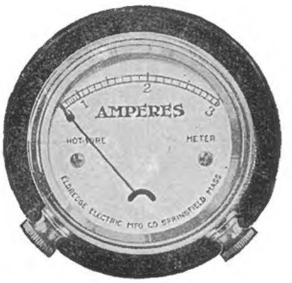


Model H, Hot Wire Meter, 0-3 amps, or 0-5 amps. Nickel case, rubber composition back. A small, quality instrument.

Price $3.75

Deal Direct
with the
Manufacturer

We will save you time and money. Our new catalog "W" is filled with "up to the minute" wireless apparatus. Our new 112 page "Book of Electrical Apparatus" contains motors, dynamos, parts and materials, meters, lighting plants, storage batteries, phonographs, motion picture cameras, etc., at prices that will positively save you dollars. Both books sent for 6 cents stamps to cover mailing.

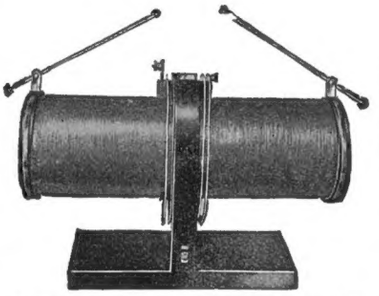
Blitzen 43 plate Rotary Variable Condenser. Glass case, aluminum plates and base. Hard rubber composition top and binding posts. The best small condenser money can buy.

Price $4.00

CLAPP-EASTHAM CO.

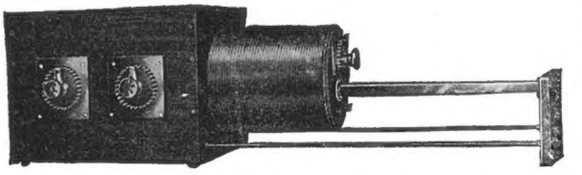
Manufacturers and Distributors of Everything Electrical

141 Main Street - - - CAMBRIDGE, MASS.



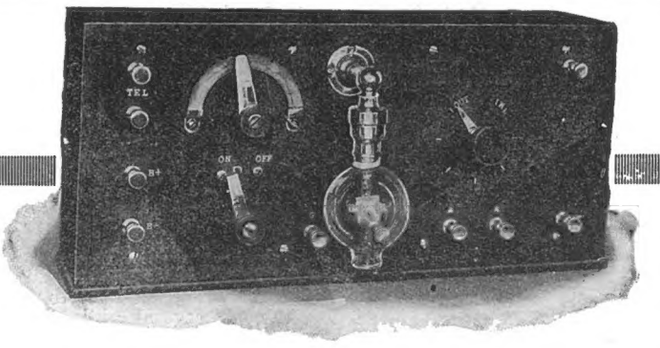
The Blitzen Tesla Coil. Works with any transformer and condenser. ¼ K.W. gives 9-inch spark, price $10.00; 1 K.W. gives 16-inch spark.

Price $16.00



The Cambridge Long Wave Tuner receives up to 15,000 meters with good antenna. A masterpiece of design and workmanship. Total length 36 inches. This tuner will enable you to receive the very long waves used by Tuckerton, Sayville, Nauen, Germany and others.

Price $40.00



Type RJ8

PRICE, $25.00

New De Forest Audion Detector

THE BEST AUDION DETECTOR EVER OFFERED FOR PRIVATE USE

¶ The Audion Detector is the most sensitive detector in existence. (Bulletin U. S. Bureau of Standards, Vol. 6, No. 4, Page 540.) The new and improved forms are more sensitive, more reliable and more adaptable than ever before. The new Type RJ8 Audion Detector represents the greatest value for the money ever offered.

¶ It is equipped with **potentiometer** control for the high voltage circuit, giving extremely close regulation which is so essential to obtaining utmost efficiency with the Audion. It is a **panel type** instrument of the very best construction. It is thoroughly reliable and constant in operation, is not affected by mechanical vibration or by the transmitting spark, and is **always** to be depended upon for reception of signals over the greatest possible ranges.

¶ It is worth a stamp for you to be informed on this and the other new DeForest instruments.

"There is only ONE AUDION—the DE FOREST"

Send stamp for M 16 Bulletin on the New Audions

De Forest Radio Telephone & Telegraph Co. **101 PARK AVENUE NEW YORK CITY**

THE ELECTRICAL EXPERIMENTER

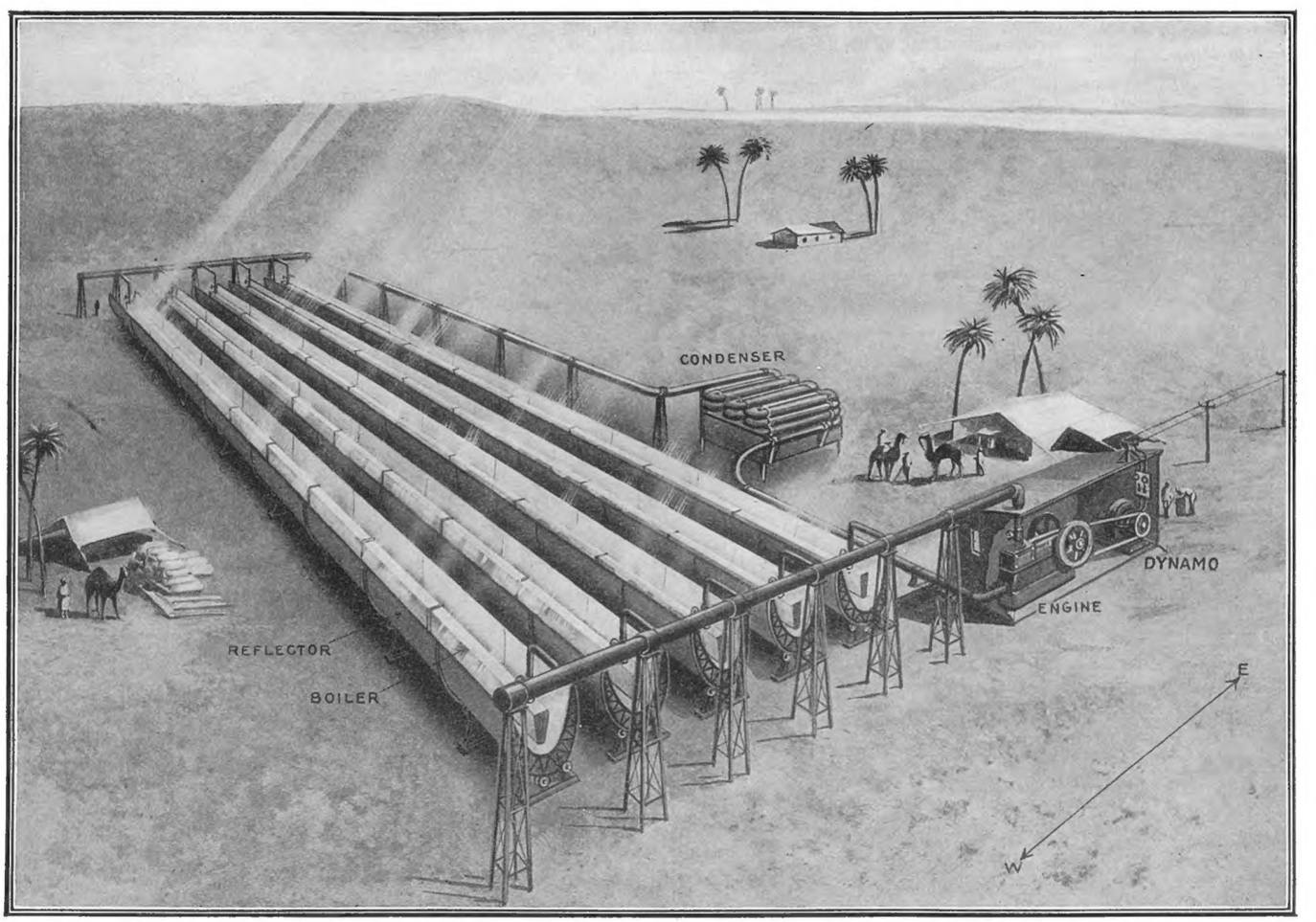
H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. III. Whole No. 35 MARCH, 1916 Number 11

The Utilization of the Sun's Energy

Years Ago Man Endeavored to Make Practical Use of the Energy Contained in the Sun's Rays—Even Tesla, the Electrical Wizard, Has Patented a Sun Motor, While the Shuman-Boy's Engine and Sun Boiler Has Developed 100 H. P. There Is Great Promise Held Forth to Future Engineers Who May Work on This Problem.

IT has been given to astrophysicists to measure the heat generated by the sun and calculate the force emanating from it. We know that the surface of our luminary gives out a heat estimated to be about 6,000° centigrade, and that its light equals that of 27,000,000,000 candlepower a quarter of a mile away. The heat which the earth receives from the sun in the course of a year would suffice to melt a belt of ice about 55 yards in thickness extending clear around the earth. Only the 2,735-millionth part of the total energy given off by the sun reaches our earth and, if this were lacking, our planet, with all its thousandfold life, its thick forests and fruitful plains, would turn into a dead, rigid ball of rock, for the average annual temperature, which is now one of 13° centigrade of warmth for Europe, would, without the heat of the sun, sink to 73° centigrade of frost, it is calculated.



A Successful 100 H.P. Sun Power Plant Located at Meadi, on the Nile, Egypt.

Every sort of light with which we illuminate our home when the greater light has sunk beneath the horizon, every fire that warms us when the solar rays can no longer do so, is a product originating in the sun. The chip of wood with which the untaught son of nature brightens his hut, the twigs with which he stokes his fire, what are they but pieces of trees that grew in the sunlight? The gas of the city dweller, the coals with which he heats his house and from which the gas has been sucked, what are they but transformed sunbeams? The coal in the grate is the petrified wood of perished forests that covered the earth's surface millions of years ago, and flourished in the rays of the same sun that ripens our corn to-day. Petroleum, that mysterious earth-oil, comes from the bodies of millions of dead and

gone animals, chiefly natives of the sea, which lived in the gray ages and fed on things growing in the sun. Alcohol is also a plant product, and the candle our ancestors took to be an ideal light, is won

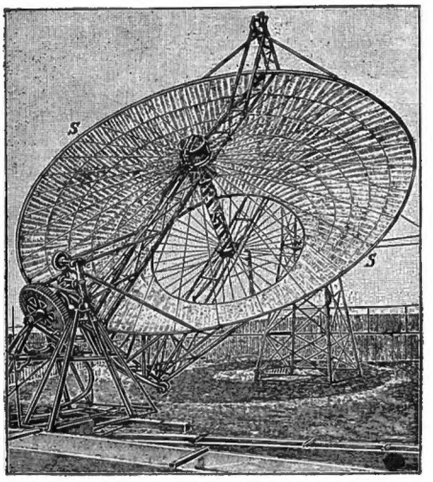


Fig. 1. Common Form of Sun Motor Adopted by Experimenters, Utilizing a Large Number of Mirrors and a Central Boiler.

from the animal and plant kingdom. The smoking fish oil lamps of the Eskimo are indirectly dependent on the sun for their fuel. And what of our own electric light? The dynamo developing the electricity is driven by steam, and the steam engine has to be fed with coal or with other materials gained from the animal and plant kingdoms. How about the waterfall? It would not exist if the sun did not suck up water from the earth's surface, and which is again deposited on the earth in the form of rain.

If it were rendered possible to use the sun's heat itself for the firing of furnaces an ideal state of affairs would be attained. There was a sun motor used for some time on an ostrich farm (see Fig. 1) in South Pasadena, Cal. This consisted of a concave mirror made of single glass planes set together, and measured about 12 yards in diameter. The sun's rays were collected and focussed on to a water tank, let into the mirror in the shape of a cylinder, 2½ yards long, which acted as its axis. When the water tank remained empty on a sunny day its walls grew red hot in less than an hour. The 400 quarts of water it contained was brought to the boiling point in 15 minutes and the steam developed drove a motor of 10 horsepower, which in turn worked a pulley raising 5,600 quarts of water per hour; a decidedly noteworthy performance.

The temperature of the sun, as aforementioned, has been calculated to be about 6,000 degrees centigrade. Several authorities point out that this terrific heat therefore precludes any possibility of the sun being a molten mass in the process of combustion. It has been thought recently by many to be a great mass of matter possessing to a remarkable degree radio-activity akin to radium. Helmholtz proposed that the sun could keep on producing energy at its present rate by accounting for same on the basis of a slight annual shrinkage in its size. From observations and measurements of this heavenly body made from year to year it has been computed that the age of the sun would, on the shrinkage basis, be 17,000,000 years.

The radiant energy received from the sun at the outer surface of the earth's atmosphere is equivalent to 7,300 horsepower per acre. Of this about 70 per cent. or, roughly speaking, 5,000 horsepower per acre, is transmitted through the atmosphere to the land surface proper of the earth, at noon on a clear day. Lesser amounts, of course, are received in the early morning and late afternoon, owing to the greater thickness through which the energy must pass.

Relative to the basis upon which solar energy is calculated for the earth's surface, this is generally made, it may be said, on the "solar constant," as it is termed, ascertained from 696 tests conducted by the Smithsonian Institute of Washington, in various parts of the world, which resulted in accepting 1.93 calories per square centimeter per minute, equal to 7.12 British thermal units per square foot per minute. This is an average value, all things considered.

Only about three-fifths of the solar radiation produce any impression on the earth, and it is only the radiant energy which falls on some material body that is converted into heat. The best body for this conversion having been ascertained to be a dead black one.

Many scientists and philosophers in the past century have tried various methods by which to concentrate the sun's rays, such as schemes utilizing an immense number of lenses built in the form of a huge cone, as previously described and illustrated at Fig. 1. A European experimenter in the year 1820 constructed one similar to this, but on a small scale. This model concentrated the rays sufficiently to melt tin at a distance of 68 yards from the apparatus, and also it was possible to cook food and melt silver instantaneously.

In the year 1882 a Frenchman by the name of M. Pifres devised a solar engine which was built on the roof of a building in Paris to drive a printing press, and the paper so published was called the "Soleil Journal." Capt. John Ericson experimented with solar engines from 1868 to 1886 with more or less success, but nothing remarkable or practical was developed. Another early worker was A. G. Eneas. His solar engines are described in United States patents issued in 1901, bearing the numbers 670,916 and 670,917.

Getting down to basic and simplified apparatus for utilizing such radiant energy as that possessed by the sun's rays, both visible and invisible, we may consider the apparatus of this nature devised by Dr. Nikola Tesla, the well-known electrical scientist. His United States patents on "Apparatus for the Utilization of Radiant Energy" bear the numbers 685,957 and 685,-958. This apparatus, intended to absorb and transform such radiant energy as that given forth by the sun, is shown in the illustration at Fig. 2.

Tesla says of this matter that his own experiments and observations have led him to the conclusion that such sources of radiant energy as the sun throws off with great velocity, minute particles of matter which are strongly electrified, and are, therefore, capable of charging an electrical conductor, or, if not so, may at any rate discharge an electrified conductor either by carrying off bodily its charge or otherwise. His patents in this direction are based on alleged discovery by him that when such rays or radiations are permitted to fall upon or impinge against an insulated conducting body P connected to one terminal of a condenser, such as C in Fig. 2, while the other terminal of the condenser is made by independent means to receive or carry away electricity, a current flows into the condenser so long as the insulated body P is exposed to such rays; so that an indefinite, yet measurable, accumulation of electrical energy in the condenser takes place.

This energy, after a suitable time interval, during which the rays are allowed to act in the manner aforementioned, may manifest itself in a powerful discharge, which may be utilized for the operation or control of a mechanical or electrical device consisting of an instrument R, to be operated and a circuit-controlling device d (Fig. 2-A).

Tesla bases his theory on the fact that the earth is negatively charged with electricity and he considers same to act as a vast reservoir of such a current. By the action of the sun's rays on the plate P there is an accumulation of electrical energy in the condenser C. A feeble current is supposed to flow continuously into the condenser and in a short time it is expected to become charged to a relatively high potential, *even to the point of rupturing the dielectric.* This accumulated charge can then, of course, be used to actuate any device desired.

An illustration of a proposed form of apparatus which may be used in carrying out his discovery is referred to in Fig. 2-B. In this figure, which in general arrangement of the elements is identical to Fig. 2-A, the device d is shown as composed of two very thin conducting plates, t t^1, placed in close proximity and very mobile, either by reason of extreme flexibility or owing to the character of their support. To improve their action they may be enclosed in a receptacle from which the air may be exhausted. The plates t t^1 are connected in series with a working circuit, including a suitable receiver, which in this case is shown as consisting of an electromagnet M, a movable armature a, a retractile spring b and a ratchet-wheel w, provided with a spring pawl r, which is pivoted to armature a, as illustrated. When the radiations of the sun or other radiant energy source fall upon plate P a current flows into the condenser, as before explained, until the potential therein rises sufficiently to attract and bring into con-

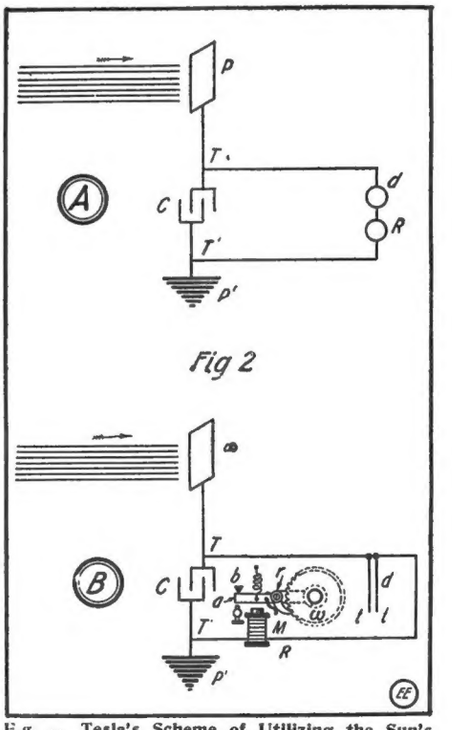


Fig. 2. Tesla's Scheme of Utilizing the Sun's Energy.

tact the two plates t t, thereby closing the circuit connected to the two condenser terminals. This permits a flow of current which energizes the magnet M, causing it to draw down the armature a and impart

(*Continued on page* 662.)

The Choralcelo, a Wonderful Electric Piano

This Marvelous Electrically Operated and Controlled Musical Instrument Is More Than a Piano—It Produces Sustained Notes of the Lowest and Highest Register Over a Range Heretofore Unattainable, and, Moreover, Is Played Like a Regular Piano

IN India, far away, as the popular song goes, the natives are content to regale themselves musically with the plaintive notes given forth by a goat skin stretched over the end of a hollow log, upon which the musician beats a tune with the flat of his hand.

The music of the cavemen was the wind sighing through the trees, accompanied by the rustle of the leaves. Even they wanted to express themselves in a harmonious manner, hence the drum, the horn and other crude instruments of musical expression.

Then we may possibly expect some marked advances in our musical culture and education since the advent of he "Choralcelo," despite the prophecies of those who take a pessimistic view of life in general.

The piano becomes a tongue-tied infant beside this latest masterpiece of the musician's art. At times its notes thunder forth and seem to shake the very earth itself, and then again they may be subdued to an elusive softness like unto the faint notes of a distant church choir.

But what is it? How is it accomplished? What is the result of many years of untiring labor on the part of several of the cleverest men of the world? What is it on which a fortune that would ransom a king has been spent? The Choralcelo!

The Choralcelo, the most wonderful musical instrument ever thought out by the human mind, is like nothing else the world of music has ever known. This masterpiece reproduces any piece of music in any form of instrument, from a string to a flute; not only does it reproduce them, but the notes emitted by it are sustained, pure and sweet, which is entirely different from the ones produced by the instruments that are in present use.

Practically all the musical instruments, previous to the invention of the Choralcelo, carry into the tone which they produce certain impurities which arise from the manner in which they are caused to vibrate. The violin interrupts the free vibration of the string by the grating rub of the bow. The piano adds the noise that results from the blow of the hammer on the string—while the organ mingles the *breathiness* of its air current with the pure vibration of the column of air within the pipe. In like manner all instruments employing extraneous contacts to start the vibration destroy the purity of the note produced. And as they seek to amplify the tone that they have produced they increase the intrusion of extraneous and false sounds. The soft pedal of the piano, the swell-box of the organ, the mute of the violin, are just so many outrages on the purity of the tone.

The Choralcelo, by the very means which it employs in producing the tones, is freed from all obstructions. Vibration without contact, involving *perfect freedom of vibration,* and thus the Choralcelo gives all the natural overtones and harmonics; rich—full—pure and perfect, thus opening to the musician wonderful possibilities of expression and emotional power of which he possibly never dreamed.

The manner in which this result is accomplished is one of wonder. It is the subtle pull of the electro-magnet which now achieves pure tone production. These electro-magnets are caused to act directly upon the strings of the instrument.

The most delicate graduation of tone power can be produced by the mere variation of the strength of an electric current, and not by *smothering* devices which the present form of instrument employs. The tone, therefore, retains all its original purity through all vibrations and intensity, something which has been impossible heretofore.

We will next inspect the mechanism employed to perform these wonders. It may be stated that the vibrating elements are caused to oscillate by means of a pulsating electric current sent through an electro-magnet acting on the vibrating membrane. The machine which breaks up continually the electric current into a series of waves is really the "heart" of the Choralcelo. The operating device consists essentially of a series of metal discs having a certain number of insulating segments inserted in their peripheries. These discs are arranged to revolve at a fixed speed. Silver-tipped brushes are so placed that they will bear upon the revolving discs. It will thus be seen that in order to produce the fundamental periodicity of any given "string" it is only necessary to rotate a disc containing a certain number of segments at the correct speed.

A large variety of combinations are possible through the manipulation of a few keys, which correspond to the stops of an organ, and such a keyboard is clearly shown at Fig. 1. This resembles a piano, and it really is one, with additional keys and pedals. The pedals are used to vary the strength of the current sent through the electro-magnets.

A tremolo effect is given by means of a slow speed interrupter giving a pulsating current at a few revolutions per second. The instrument which produces this effect is depicted on the right of Fig. 2, while the one toward the left reproduces tones representing a flute. The regulation piano tone is produced with the usual percussion hammers, which may be thrown into or out of action by the pressure of a key. The staccato notes of the piano may be struck upon strings already vibrating with the pulsating current. Thus sustained notes of a higher pitch are produced upon the string. A piano which employs both the electro-magnets and hammers is clearly shown on the left of Fig. 3. Note the large number of wires which are employed for connecting the various magnet coils. It is an engineering feat in itself to even make and wire the various circuits.

Marvelously sweet tones are produced by vibrating pieces of brass, wood and aluminum. In fact, any resonant body susceptible to vibration may be made to emit tones. In order to cause these bodies to vibrate it is

(*Continued on page* 664.)

Fig. 1. Appearance of Choralcelo, Showing Keyboard

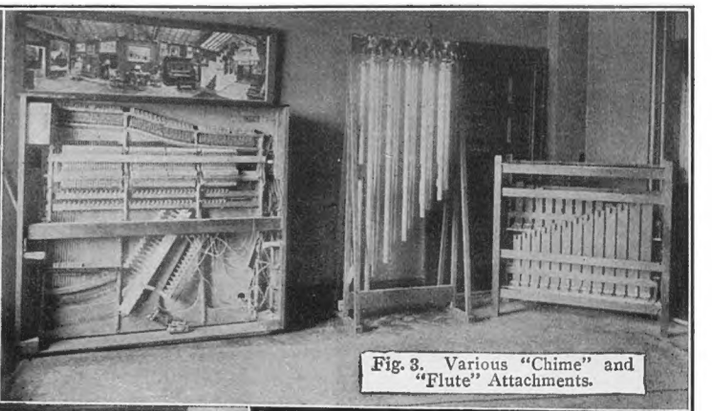


Fig. 3. Various "Chime" and "Flute" Attachments.

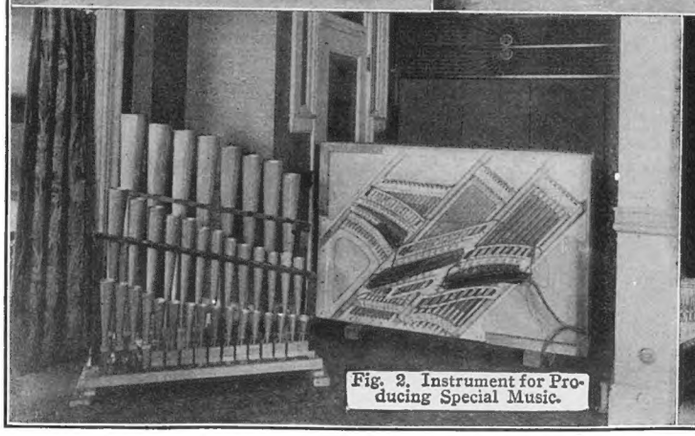


Fig. 2. Instrument for Producing Special Music.

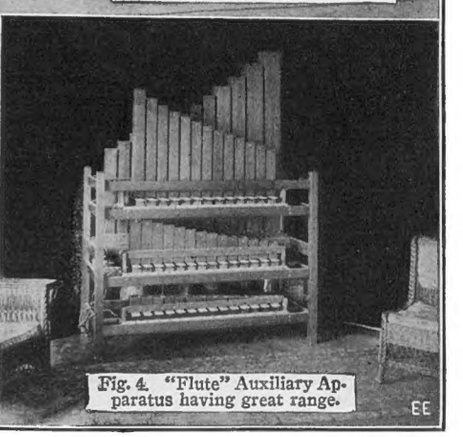


Fig. 4. "Flute" Auxiliary Apparatus having great range.

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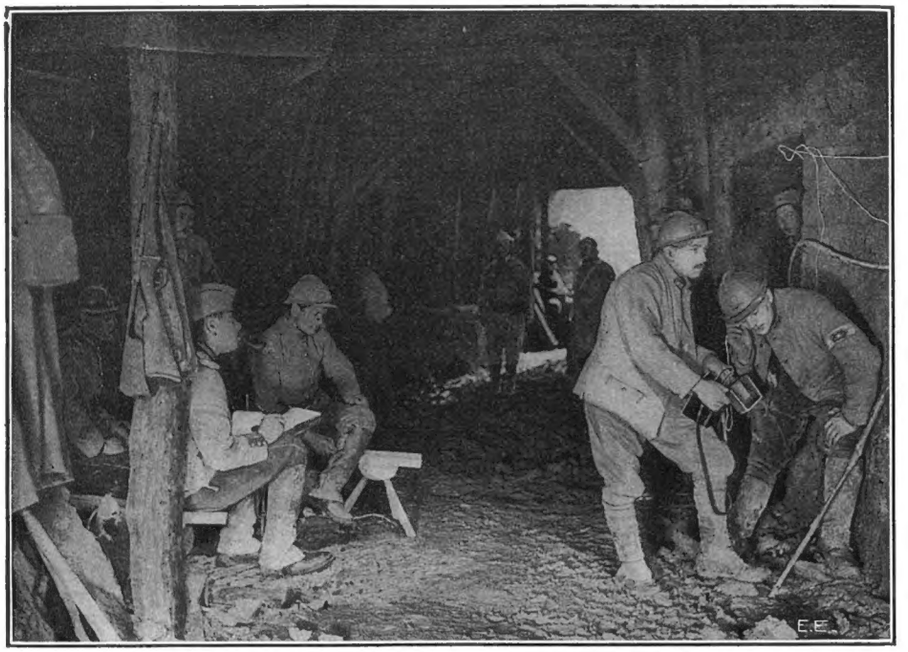
New Uses for Electricity in the War

MICROPHONE NOW DETECTS MINE SAPPERS.

Electricity has been utilized to an unimaginable extent in the present titanic struggle across the ocean. In the interesting illustration shown herewith we see one of the latest adaptations of this wonderful agent of man and involving the microphone. The microphone, the electrical instrument which will pick up a delicate sound and transmit it in the form of undulating electric currents over a circuit, has solved many an important problem in the past, and especially during the present war.



How French Mine Sappers Utilize the Microphone to Hear the Germans Counter-Mining by Sound Conduction Through the Earth.

The two men at the right of the illustration are seen in the act of listening for German mine "sappers," and the men here shown are French. They, as you will note, are wearing shrapnel-proof metal helmets. A small box contains the batteries, etc., and the soldier leaning forward and listening so intently has in his hand a small but delicate watch case telephone receiver which is connected with the wires running along the wall to a supersensitive microphone placed in contact with the earth wall of this underground passageway. The French sappers are running a counter-mine out of the entrance of which one of the men is looking, as perceived at the right of the illustration.

It is indeed remarkable to what distances such sounds as those produced by pickaxes and shovels can be propagated through the soil. The sound conduction is also enhanced wherever rock or mineral formations are present to any extent in the earth. While the opposing sappers may explode their mine and blow up the French soldiers here observed resting so contentedly in the act of writing letters home, there is some consolation in knowing that they have a fair chance to climb out of the underground passage before the German mine has been driven far enough to do any damage, thanks to electricity.

TO BUILD NEW MARCONI TOWER AT CAPE MAY, N. J.

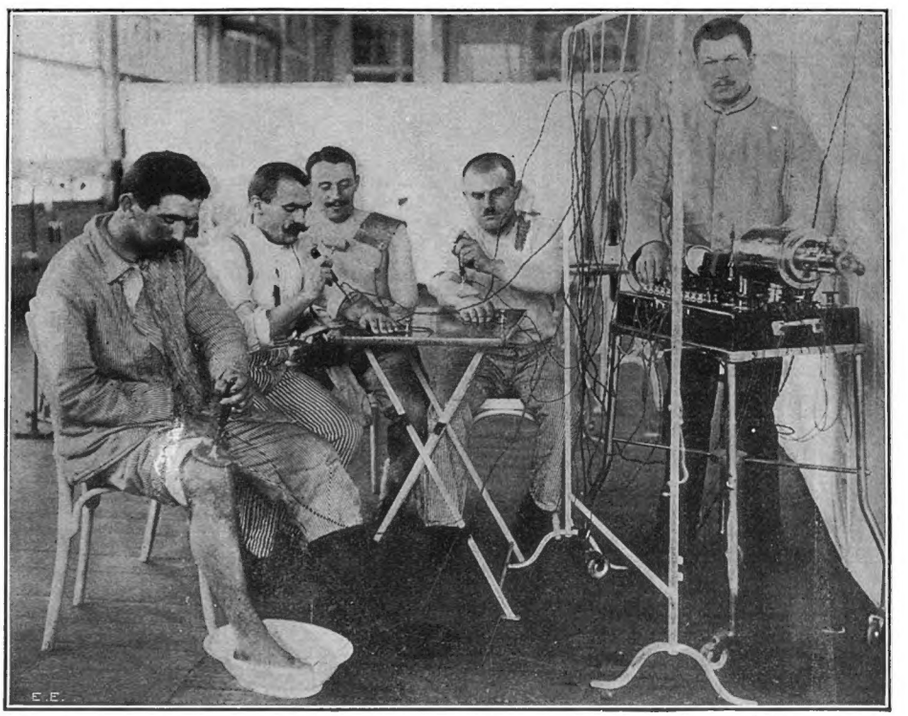
Sherman Sharp, a contractor of Cape May, N. J., has been awarded the contract to build the new building for the Marconi Wireless Telegraph Co. at Cape May. The building will be located about a half mile back from the shore on the site of the city water works.

The City Commissioners have leased the property to the Marconi company for 10 years, and the operation of erecting a tower 140 feet high will be started immediately.

HOW ELECTRICTY AIDS GERMAN SOLDIERS TO GET WELL.

The rigors of a hard winter in the trenches, besides the stiffness and other muscular complications resulting from bullet and shell wounds, are bound to show up in the sturdiest soldier sooner or later. Another important factor to be reckoned with in modern warfare is the tremendous nervous strain under which the men labor during or even before the actual fighting, owing to the heavy cannon and gun fire, as well as that of the machine guns, etc., which results in nervous exhaustion, and indeed in some cases in complete collapse.

In this event the soldiers so affected are invariably sent to the rear or to the nearest field hospital, if properly equipped for treatment of this kind. In the illustration herewith a number of convalescent German soldiers are observed taking treatment from a specially designed electro-therapeutic machine, supplying current of a certain frequency and strength. The current produced by this particular machine may be so regulated, when desired by the operator in charge, that it will have the characteristics of the well-known Faradic current, used extensively in the treatment of rheumatism and like complaints. Again the current may be specially controlled and regulated to the proper frequency and wave form adapted especially for the treatment of nervous exhaustion previously mentioned, which ailment, by the way, has been more noticeable in the present war than in any previous conflict.



Medem Photo Service

German Soldiers Undergoing Electrical Treatment for Stiffened Muscles Nervousness and Other Ailments.

AGING WINE BY ELECTRICITY.

A method of "aging" raw wines and spirits by electricity has been perfected by Professor Charles Henry of the University of Paris (the Sorbonne), and it is already being successfully used in some of the Burgundy wine districts. The process is said to impart to liquors the same properties which they acquire by being kept for a number of years in cellars. The spirit or wine is placed in a special receptacle fitted with two tubes called "purgers," and the tubes are charged with high tension electricity at from 60,000 to 120,000 volts. The result is that all the bacteria, ferments and impurities collect in the tubes and are removed and all further ferment tion is stopped. The process is very rapid, and the cost is less than two cents per hundred gallons. Similar experiments are now being made with beer and essential oils.

Electrocuting Superfluous Cats and Dogs

WHEN your favorite Tabby or Fido strays away or is turned out for good you would like, doubtlessly, to see it killed as humanely as possible, if that is to be its end; and killed all such animals invariably must be, especially in large cities, where the total number of unclaimed pets gathered up by the authorities is truly astonishing.

Electrocution, now widely adopted in various State prisons, has been happily incorporated in the latest apparatus employed by the Animal Rescue League of Boston, Mass. The illustrations here shown and reproduced through the courtesy of Huntington Smith, director of the above association, depict the electrical apparatus used for rapidly and painlessly killing such unlucky quadrupeds. Besides the apparatus installed in Boston for this purpose, there have been similar outfits adopted by over twenty other cities, which in the past five years have helped to destroy an unbelievable number of such animals.

In the year prior to 1915 there were destroyed no less than 480,848 small animals by 252 humane societies and their agents. In the past and, of course, to a very large extent at the present time there are several different methods employed for disposing of superfluous animals of different kinds, but mostly cats and dogs which are turned out of homes when people move away, etc. Among these methods are those involving the use of poison, chloroform, carbon monoxide, illuminating gas and shooting. None of these methods is in any way as humane as the new electrical method for exterminating such animals. The electrocuting outfit was first installed in the Animal Rescue League of Boston in 1911. It possesses all the best features recommended by those in charge of this kind of work, besides being highly recommended and advocated by many members of the medical profession who have looked into the subject deeply and who believe that life is cut off before any pain can be felt.

In the illustrations herewith we perceive (the center photo) how a dog is placed in one of the electrocution chambers. This cabinet measures about 2 feet 6 inches wide by 6 feet long and stands 4 feet 6 inches high. It is so mounted that it is at all times convenient for the operator to place the animal in the chamber. A metal pan is placed in the electrically insulated inner cabinet, while above it is fastened at either side; there is mounted a metal bar from which is suspended a strong spiral spring fitted with snap hooks at the free end. The lower electrode or pan is joined to one pole of a high-tension transformer, and the metal rod carrying the spiral spring electrode to the other high-tension pole. When the door of the cabinet is open the transformer primary is automatically opened also, to protect the electrocutioner; but when the door is closed the primary circuit of the transformer is completed. A flexible metal collar fitted with suitable electrode points is placed around the dog's neck and the spiral connection is hooked up to the collar. This stage of the electrocution is seen in the center illustration, with the animal alive, standing in the metal pan. In a second's time the door is closed and the dog receives the full strength of the electric current, which is believed from careful observations to kill him instantly, so that no pain whatever or torture is experienced. The illustration at the left of the group depicts the dog after electrocution.

In the illustration at the right the electrocutioner is seen holding the remains of an extinct feline. The apparatus for doing away with cats electrically is fitted up with metal electrodes hung at either end of a slate tray. The top of the cabinet automatically operates the transformer circuits, as in the case of the machine previously described. The cover is rigged up with a foot treadle so that by the pressure of the foot the top may be opened or closed, thus leaving both hands free with which to manage the animal, for, as most of us know, it requires some skill and agility to put a cat in a box or bag. The cat is grasped firmly with both hands and is then placed in the box or cabinet so that its fore feet rest on one electrode, while the hind feet rest on the other. The instant the cover is closed the high voltage is passed through the body of the cat and it is rendered unconscious or dead instantaneously. Peculiarly enough, it has been ascertained that cats require about twice the length of time necessary to electrocute dogs. Contrary to the reader's probable impression, this is not believed to be due to the proverbial nine lives accredited to the feline, but to its inherent vitality, to its higher organic resistance to the electric current and also to variations in the contact made, depending on the dryness of the skin.

A most interesting fact in connection with the electrocution of these animals is that the current when first switched on rapidly reaches a maximum and then falls off to about one-half of this value. The voltage employed for this work varies from 4,000 to 5,000. It is believed that a much lower potential will do the work in a satisfactory manner, but so far such tests have not been made, due mainly to humanitarian reasons. One kilowatt-hour of electrical energy will suffice to kill from 800 to 1,000 animals, it is said. An alternating current has also been found to be the best for this work.

Electrocuting Cats and Dogs at the Animal Rescue League, Boston, Mass. The Most Humane Way in Which to Kill Superfluous Pets.

ELECTRIC LAMP THE BEST READING LIGHT.

Recent scientific investigation has shown that the reading lamp which is equipped with the proper electric incandescent light and shade is superior to any other form of lamp for reading purposes. The essential features of this lamp are that the incandescent bulb is all frosted and that the shade is so arranged as to protect the eye from the direct light of the bulb.

One occasionally hears a preference expressed for the kerosene lamp for reading purposes, the statement usually being made that it is easier on the eyes. This is doubtless due partly to force of habit and partly to experience with unsuitable electric lamps.

The brilliancy of the incandescent lamp can be reduced to approximate that of the oil lamp by using an all-frosted bulb. By using a suitable shade the eyes will be still further protected and the light directed onto the book or paper which is to be read and a pleasing color tone may be obtained. The light from the oil lamp is made up principally of yellow, orange and red light, while the incandescent lamp gives much more nearly white light from which by means of proper shades any color can be obtained.

Proper lighting for reading purposes is a big factor in the general health of persons, since eye-strain reacts on the body, causing headaches, nervousness and indigestion.

Killing the Smoke Nuisance Electrically

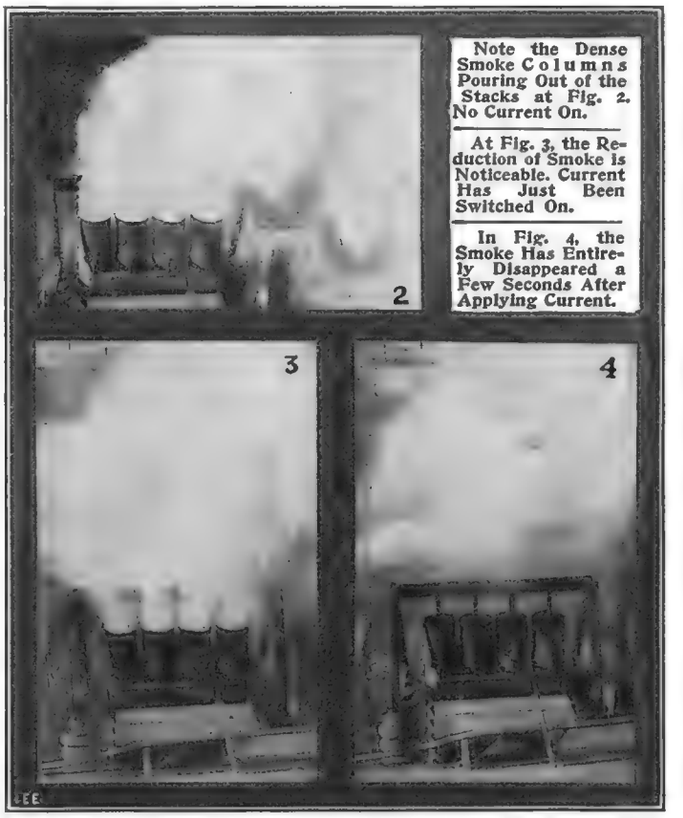
By Samuel Cohen

WE watch the smoke floating upwards from the chimneys of our manufacturing plants with thoughts that differ with the individual. The housewife thinks only of the damage done to her freshly washed clothes. The engineer thinks of the inefficiency of the plant, while the good citizen thinks of the effect such smoke will have on the health of the community. We will not enter into a discussion here as to which one takes the proper or best view, for it is well known that a pure and clear atmosphere is necessary for the health and welfare of a community.

The smoke nuisance has been made the subject of laws in many cities, but the manufacturer was at a disadvantage. No practical or reliable smoke prevention method was within his reach until recently, so that he had to rely on special grates, the use of hard coal or else on expert firing to prevent the levying of fines.

Leading engineers and scientists of this country and abroad have been constantly laboring on this problem, and although some of them have invented schemes for preventing the unnecessary smoke from entering the atmosphere from the stack, yet these were not of commercial value on account of being too complicated. The electrical precipitating method, however, has proved far superior to any other in its operation. The operation of this scheme is described herewith.

The electrical precipitation apparatus was originally devised by Sir Oliver Lodge, but it was finally developed and perfected by The Research Corporation, under the direction of Dr. F. G. Cottrell, the inventor of the present form of this apparatus. Since smoke is nothing more or less than minute particles of carbon and other solids suspended in the air the basic principle of his scheme for precipitating smoke, dust and mist is to charge all the particles in the stack with electricity. In this way they will be collected on the side of the conductor, and as soon as a large quantity of the soot is accumulated, it falls down to the bottom of the stack. A schematic diagram showing the connection of the various apparatus used is depicted in Fig. 1. It will be observed that a transformer is employed for supplying the high tension current. The voltage required depends upon the size and condition of the plant in which the apparatus is to be installed, so they vary from 50,000 to 100,000 volts. The secondary of the transformer is connected to a special rectifier which virtually consists of a rotating arm of four poles connected as perceived in diagram. This arm is revolved at constant speed by a synchronous a.c. motor. One of the stationary terminals is connected to a wire suspended in the stack and properly insulated from it by a high tension insulator. The opposite terminal from the stack is connected to the ground, which consists of a large number of pipes placed in the base of the chimney, while the other two terminals are interlocked with the secondary of the transformer. This rectifier is used to change the high tension alternating current to direct current, which is of extreme importance, as the whole secret of this type of apparatus lies in charging the particles with one kind of charge, so that they may adhere to one of the terminals and are thus prevented from escaping out of the stack. If an alternating current supply is not available, a motor-generator set is employed and the rectifier revolving disk is then placed on its shaft.

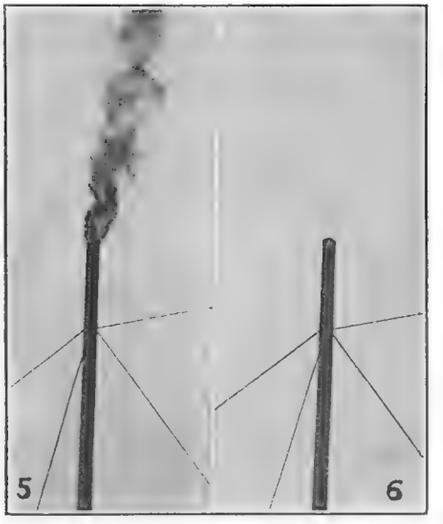

Note the Dense Smoke Columns Pouring Out of the Stacks at Fig. 2. No Current On.
At Fig. 3, the Reduction of Smoke is Noticeable. Current Has Just Been Switched On.
In Fig. 4, the Smoke Has Entirely Disappeared a Few Seconds After Applying Current.
2
3
4

Several interesting illustrations are herewith given showing stacks fitted with this apparatus for eliminating smoke electrically. Fig. 2 illustrates such a stack when the current was turned off; note the density of the smoke cloud rising from it. As soon as the current was switched on, the smoke was reduced (see Fig. 3), and a few seconds later it had entirely disappeared, as shown by Fig. 4. Two other striking illustrations which show the marvelous efficiency of this apparatus are portrayed in Figs. 5 and 6; the former depicts the dense smoke issuing from the chimney, while the latter illustrates the appearance of the flue when the current was turned on.

Although the above mentioned apparatus is being extensively employed in the precipitation of smoke, it has also been used

(*Continued on page 669.*)

Fig. 7. A Laboratory Demonstration of Smoke or Vapor Elimination Electrically. Compare with Fig. 8 at Right.



The Smoke Nuisance Eliminated. Compare Fig. 5 (no current on) with Fig. 6, Where High Tension Electric Current Has Been Applied to Interior of Stack.

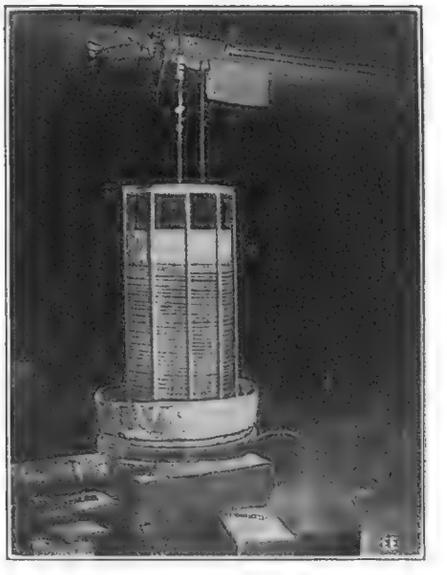


Fig. 8. The Vapor Cloud Has Vanished a Few Seconds After Applying the Electric Current. Compare with Fig. 7 at Left.

ELECTRICITY ON OCEAN LINERS.

The amount and variety of electrical apparatus carried by any large ocean liner is quite astounding. From the wireless aerial suspended high above the upper deck to the cargo lamps in the lowest hold electricity is in constant use.

The usual electric installation on a large liner consists of four engines and dynamos, each dynamo having a capacity of 400 kw. at 400 volts. There are also auxiliary generating sets, consisting of two 30-kw. engines and dynamos situated on a platform in the turbine engine room 20 feet above the water line. These auxiliary emergency sets are connected to the boilers by means of a separate steam pipe, so that should the main sets be temporarily out of action they can provide current for such lights and power appliances as would be required in the event of emergency. Working in conjunction with these emergency sets is a battery with a capacity of 3,500 ampere-hours, situated on the promenade deck, forward of the first-class smokeroom.

The electric lighting on such a steamer is equal to that of a good-sized town, the total number of incandescent lights being about 11,000, ranging from 8 to 16 candle-power. There are special dimming lamps in the first-class rooms, and the electric bell system includes 1,700 bell pushes and 29 indicator boards distributed all over the vessel, with fire alarm pushes distributed throughout the great liner and an alarm bell and indicator in the chart room.

There are electric heating, power and mechanical ventilation apparatus in service, altogether 188 motors and 600 electric heaters being installed throughout. The system of ventilation consists of electrically-driven fans—some suction, others pressure, and in many cases provided with steam coils for warming the air. Loud-speaking telephones of navy pattern are fitted for communication between the wheel house on the bridge and forecastle and after docking-bridge, engine room and wireless room, and also in the chief engineer's cabin.

The telephones are operated both from the ship's lighting circuit, through a motor generator, and alternatively by a stand-by storage battery, which is introduced in the circuit, should the main supply fail, by means of an automatic switch. There is also a separate telephone system for intercommunication between a number of the chief officials and service rooms, through a 50-line exchange switchboard. A number of the pantries and galleys are also in direct telephonic communication.

The apparatus for wireless telegraphy consists of a 5-kw. motor-generator. The house for the instruments is situated on the boat deck. There are four parallel aerial wires extending between the masts fastened to light booms; from the aerials connecting wires are led to the instruments

(*Continued on page* 655.)

What All the Electric Plants in America Could Do

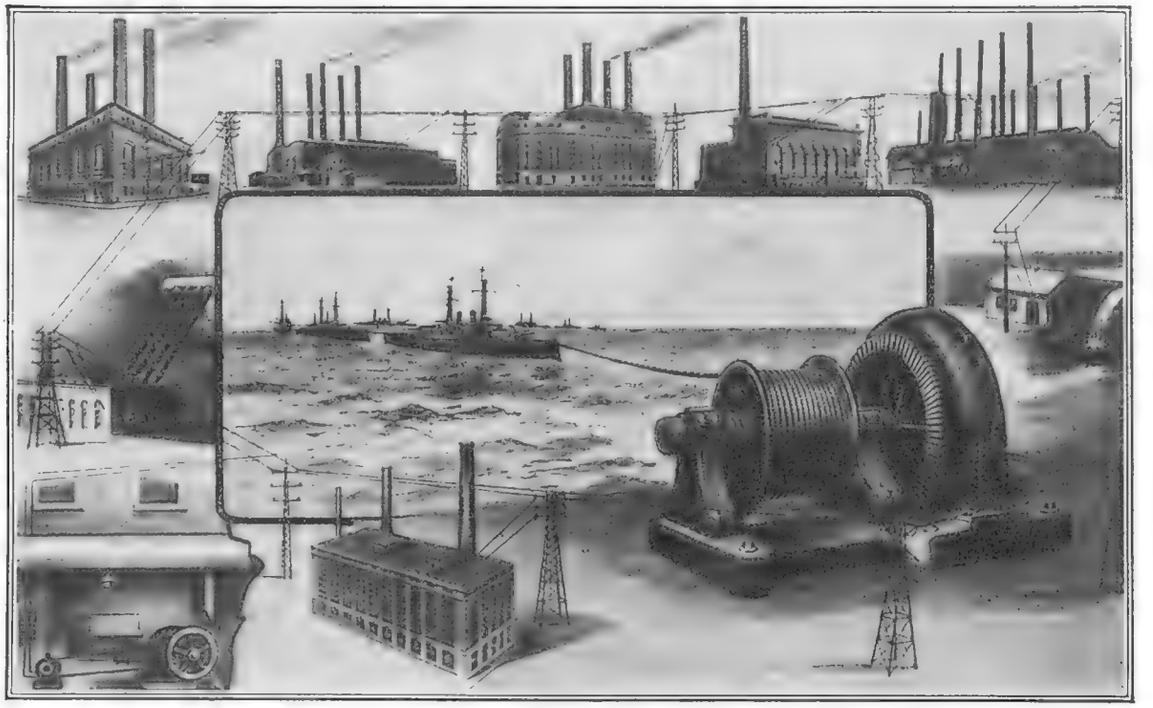
IT was after Watt's wonderful discovery of the power of steam, resultant from observing a tea kettle, it is said, and later terminated in the invention of his steam engine, that people realized its great energy producing possibilities. They then began to build Watt steam engines and used them advantageously for driving their machines. Although this source of power has rapidly increased in use the introduction of the generation of electricity, the internal combustion engine and modern water power developments have revolutionized power plant design and made practical the small, isolated plant. To-day electricity is invariably used in manufacturing plants for light and power, which, in those requiring a large amount of energy, is usually generated by steam driven generators, while gas is used in some of the larger plants.

One cannot conceive of the vast amount of electrical energy that is daily being generated throughout the United States. The following comparisons will serve to make somewhat clearer the great magnitude of the energy developed by all the plants in this country, including those driven by water, wind, etc. If these were connected in a single, continuous circuit with its terminals linked to some device, as a motor or electric lamps, we could then readily observe the effect of this tremendous power.

One of the simplest electrical devices known to the average person is the incandescent electric lamp. If we could obtain a sufficient number of these lamps of the 20-watt size, and string them along a wire line from *the earth to the moon*, the lamps being 15 inches apart, the amount of current necessary to light them would then represent the amount of power generated by all the dynamos in the United States, which in their entirety have an output of about 20,350,000,000 watts per hour.

For another illustration we might stretch a line of two conductors 15 *times around the earth* and place on this 1,000-watt lamps one hundred feet apart. The power required to light this gigantic line would also represent the electrical energy produced by these ever-humming dynamos.

An interesting comparison showing still another effect of this tremendous electrical energy is noted herewith. A fleet *thirteen times larger* than Uncle Sam's navy could be hauled through the water by means of a massive electric motor stationed at some fixed point. The power would have to be supplied from the generators through extremely large conductors, of course, in order to withstand the enormous electric current. The motor would also be of a special design, and of truly gigantic size in order to develop 27,614,766 horsepower. The only difficulties that would probably interfere with such an enterprise would be in obtaining or building transmission line, the motor and a proper foundation. This latter would have to be very strongly built to withstand the torsion when the motor started to haul the vessels.



The Total Electric Power Developed by United States Electric Plants Could Haul a Fleet Thirteen Times Larger Than Uncle Sam's Navy.

Again, if 20,350,000 1,000-watt lamps were connected to a common circuit and grouped in such a manner as to cause their total light to fall upon a concave reflector the total candle power of the light produced by this lamp bank would be about 18,498,150,000, which is enormous, of course, in comparison with the largest lighting displays with which we are ordinarily familiar.

A simpler lighting arrangement than the one before mentioned might be obtained by using two proper sized carbon electrodes, connected to some source of current and operating them as an ordinary arc lamp. The light evolved would be of such magnitude that it would be detected for several hundred miles, of course, but the curvature of the earth is not taken into account in stating this distance. The heat produced by such a scheme would be so terrific that anything known to man would be boiled.

This vast sum of energy is nearly inconceivable.

The "Nokolyd" Motor Car Rear Signal

Our readers will find it worth while looking into the merits of this automobile rear signal, as it is one of the most ingenious of all the automobile devices tested by the Safety First Society.

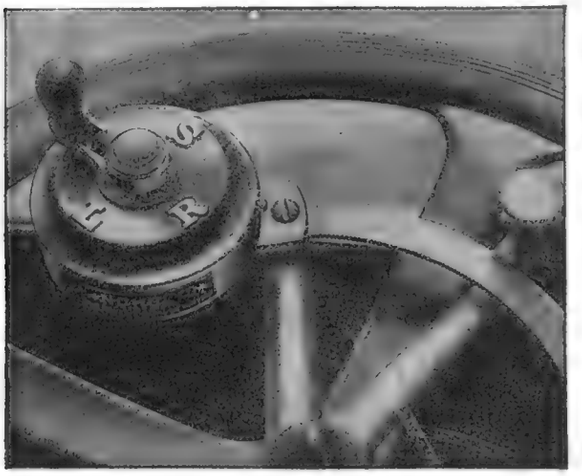


Fig. 1. Control Handle for Operating "Rear" Auto Signal.

The device is electrical. It is operated from the storage battery, which forms part of the equipment of every automobile, or it may be operated by ordinary dry cells. As each signal is set the current is automatically cut off, from which it becomes apparent that the current consumption is very low.

The controlling mechanism (Fig. 1) is fastened to the steering wheel, and within is an automatic stop mechanism which operates in a similar manner to a Postal Telegraph call box. The dust-proof box at the rear has a square member inside with four faces marked "stop," "right," "left" and the fourth space is plain white and shows when the controller is in a neutral position.

When the controlling lever is turned to the letters "S," "R," "L," or "O," the square member in the rear is turned by an electric magnetic device until the face "stop," "right," "left," or blank, corresponds to the letters on the controller. The controller can be turned one complete revolution without stopping at the intermediate letters, and the square member will also turn one complete revolution (Fig. 2).

Fig. 2. How New Auto "Rear" Signal Appears.

The "stop" signal shows white letters on a red background; the "right" signal shows black letters on an orange background; the "left" signal shows white letters on a green background. Both the "right" and the "left" signals are supplemented by arrows showing the direction. By day the signal is plainly visible for a long distance and by night it is automatically illuminated. A tiny bell rings when the signal is given, which informs the operator that the instrument has registered correctly.

FIREMEN AND ELECTRIC POWER LINES.

The slight danger that firemen run through the electric current passing from heavily charged wires along the stream of water they are squirting is proved by an experiment conducted by Ugo Tartaglini and reported in *La Scienza per Tutti*.

A trolley car wire charged with a direct current of 525 volts had one end grounded; on the other end he directed a stream from a hose with a nozzle 15 millimeters in diameter. At 2.20 meters distance a voltmeter attached to the nozzle registered 20 volts. At 65 centimeters distance it registered 70 volts and at 20 centimeters 210 volts. The average man can stand a current of 50 volts without serious shock, so a fireman who holds his nozzle 5 or 6 feet from a live wire runs no great danger.

Mr. Tartaglini made the same experiment on two lines of alternating current, one with 2,300, the other with 4,600 volts, and the voltmeter did not register any current in the stream of water, although a slight shock was perceptible when he put his hand into it. With a chemical extinguisher he got a current of 1,550 volts at 225 millimeters from a wire carrying a current of 2,050 volts.

CALIFORNIA YOUTH EXPLAINS NEW WIRELESS PHONE.

Earl C. Hanson, a Los Angeles youth, states that he has evolved a wireless telephone apparatus capable of operating between the shore and boats at sea. Young Hanson believes his system will render life saving in the future far easier than it has been heretofore.

Hanson has been working on his idea for years. He has applied for a patent, and those who have inspected his workshop pronounce his scheme feasible. For the benefit of the skeptics, the inventor recently gave a demonstration at the Venice pier, when he explained how his apparatus works.

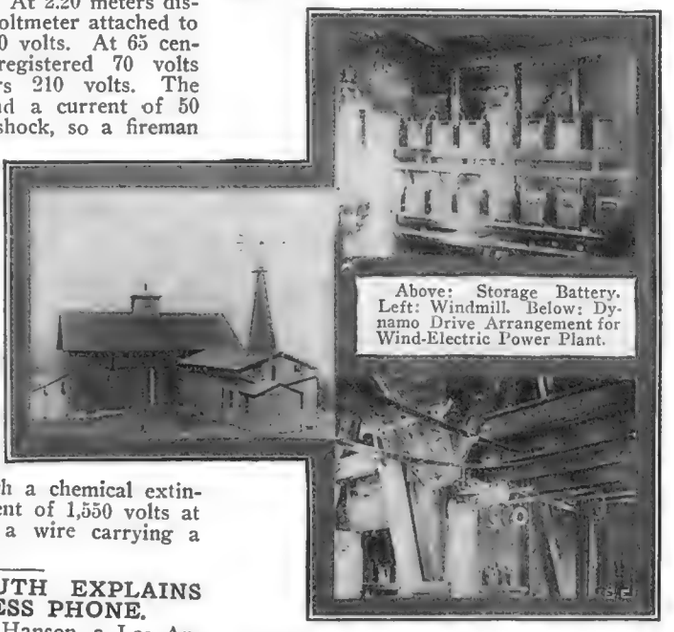
Hanson, who began his work on the instrument when he was 12 years old, declares that the apparatus is inexpensive. A case two feet square will hold it. It can be operated like an ordinary telephone. The world has been a long time waiting for such a device.

WINDMILL GENERATES ELECTRICITY FOR HOUSE AND BARN.

By H. E. Zimmerman.

It looks as though the farmer, who has learned to appreciate the cheap power produced by the windmill, is going to extend its utility by inducing it to make electricity as well as to pump water. A Wisconsin farmer—J. F. Forrest, of Poynette, that State—has adopted a very unpretentious and practical method of carrying out this idea. To a 12-foot windmill on his farm he has harnessed a dynamo. This, in connection with a storage battery, converts and stores the energy of the wind into that of electricity. The amount thus rendered available is sufficient to light a system of 25 lamps distributed through the house and barn and to operate an electric flatiron and vacuum cleaner. Feed is also ground for the stock and conveyed to bins through a canvas conveyor.

The lighting system is a low-pressure, 30-volt affair, while the flatiron and vacuum cleaner are supplied from a separate 110-volt generator. The storage battery and generators are located in a shed, or wing of the barn, over which the windmill is erected. Specially designed generators and governor pulleys serve to stabilize the usual erratic speed of the windmill. An automatic cut-out in circuit between the generator and storage battery keeps the current in the latter from flowing back into the generator and reversing its polarity. With the electricity costing practically nothing after the equipment is fully installed, the owner's plan is to use it lavishly while the wind blows, and save it during the calm. Some day the windmill-electric plant may be so common that we no longer will look upon it as a curiosity.



Above: Storage Battery. Left: Windmill. Below: Dynamo Drive Arrangement for Wind-Electric Power Plant.

AS OF OLD.

Fond Mother—"Bobbie, come here. I have something awfully nice to tell you."

Bobbie (age six)—"Aw, I don't care. I know what it is. Big brother's home from college."

Fond Mother—"Why, Bobbie, how could you guess?"

Bobbie—"'Cause my wireless won't work no more!"

The carelessness of some people is astounding. A recent report has it that a baker stepped on a cinnamon bun and the "currant" ran up his spine!

AN IMPROVED POLICE TELEGRAPH BOX.

By Warren E. Fastnacht.

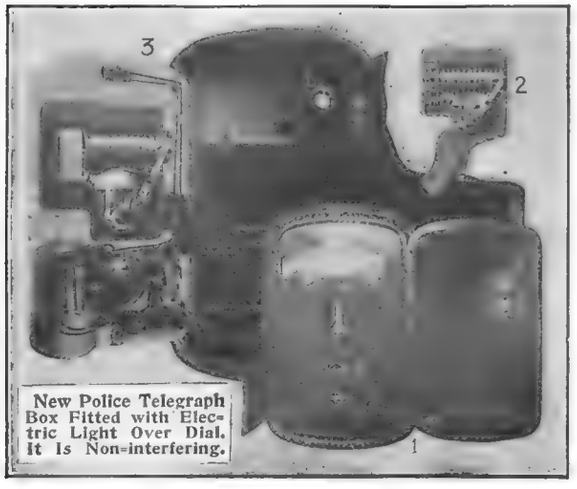
Police telegraph boxes are very often located in such a position that it is impossible for the officer to see the index dial at night, and unless he uses his electric pocket-light or a match he very often sends in the wrong report. In this improved box there is a light over the index dial, which is operated by the button in the end of the index lever; the officer pressing this button in the act of setting the lever to the proper code index, see Fig. 1. In other boxes use is made of illuminated dials of opalite glass, lighted from the rear. This opalite plate with black letters makes an efficient dial, both day and night.

In the smaller cities very often the boxes are placed far apart and, as the officers' beats overlap, a number of them report from the same box. The greatest number of signals which can be sent in from the boxes on the market at the present time is seven, and this does not meet the demand in many cities. Twelve different signals can be sent in from this new box and, as the code is made up of a number of round head screws properly spaced in holes on a revolving cylinder or drum (see Fig. 2), the code or the number of the box can be readily changed without removing the mechanism. In police reports each officer has a particular number or report at each box, and this number or report is always followed by the number of the box, so that the desk man knows exactly where the report comes from.

This set is non-interfering, as the moment the drum starts to revolve the index lever is locked and remains locked until it completes its function.

To protect the boxes and mechanism and also the officers from burn-outs or shocks, the inner boxes are wholly constructed of asbestos wood. The offices are further protected, aside from grounding the outside shells, by enclosing the entire receiver cord in a flexible rubber tube.

Very often there are repairs to be made after dark and it is not very satisfactory or handy for one man to use a flash-light or a lantern. In this box there is a small spot-light placed in an upper right corner of the inside chamber and mounted on a ball socket joint, which permits its being directed toward any part of the mechanism (see Fig. 3). This light as well as the one



New Police Telegraph Box Fitted with Electric Light Over Dial. It Is Non-interfering.

above the index dial are supplied from the local talking battery.

By the removal of only three screws, the whole of the signaling mechanism, including the index lever and starting lever, can be removed from the cabinet and taken in somewhere to be repaired. In removing this mechanism the index and starting levers pass through openings in the door of the inner chamber.

SUBSTITUTES FOR COPPER IN GERMANY.

So scarce has copper become in Germany, owing to the trying conditions of the war, that substitutes have been found to replace the copper wherever possible, especially in electrical plants, where, of course, such large amounts of this valuable metal are used. The new regulations of the German Association of Electrical Engineers cover this saving of copper by the substitution of other metals, notably zinc and iron.

Zinc busbars are advocated, and tables have been worked out for the carrying capacity of same, as well as for zinc bolts and zinc and iron wire. Where zinc is used its low mechanical strength, low elasticity, low melting point and its sensitiveness to high and low temperatures must be taken into account, of course. Wherever iron and steel are used for contacts they must be protected properly by means of zinc plating, lead plating, or else by greasing, etc.

With regard to iron busbars, the rule in the case of direct current for the permissible current is to have the relation of 1 to 2.8 to the permissible current in copper bars of the same dimensions. If the war continues copper will be nearly unknown in Germany.—*Elec. World.*

WIRELESS SERVICE DIRECT TO ARGENTINA.

Chauncey Eldridge, president of the Federal Holding Co., of New York City, which controls the Poulsen wireless telegraph patents in this country and has for three years operated a wireless system between San Francisco and Honolulu, announced recently that the company had obtained a concession from the Argentine Government for the erection of a high-power wireless station at Buenos Aires.

Mr. Eldridge said that it was intended to begin the building of stations with wireless towers 1,000 feet high near New York City and near Buenos Aires within a short time, and that probably within a year there would be for the first time direct communication between this country and South America by wireless.

The proposed wireless towers of 1,000 feet in height will be higher than any now in use, and the distance of 4,600 nautical miles between New York and Buenos Aires is a greater distance that any now spanned by ordinary radio stations. The longest wireless span at present in commercial operation is from Tuckerton, N. J., to Eilvese, Germany. The Tuckerton station uses the Poulsen wireless apparatus of less than 100-kilowatt capacity. The proposed plants will have a 300-kilowatt capacity.

AN ELECTRIC SIGN THAT DANCES.

One of the latest electric signs which interests thousands of persons nightly is seen herewith. We illustrate night view of the sign. The operation of this magnificent sign is indeed interesting as the mammoth figure, representing a Scotchman, continuously performs numerous steps of the "Highland Fling." This huge figure is 47 feet high and is mounted on a frame 50 x 50 feet. Upon the same frame the words "Haig and Haig" with the other words of the sign are mounted. The large letters are 12 feet high, while the others vary in size.

In this Latest New York Electric Sign the Highlander Dances Briskly, Attracting Great Crowds Nightly.

This sign employs about 2,000 incandescent electric lamps, which are controlled automatically by an ingenious flasher switch. This is another addition to the spectacular array of signs studding Broadway at 46th street, New York City, aptly called the "Great White Way." This unique display was built by O. J. Gude & Co.

OUR NAVAL RADIO SERVICE.

Our naval radio service now includes 47 land stations scattered all over the world. Two of these are high-power stations having a generating apparatus of 100 kilowatts or more. They are located at Darien on the Canal Zone and at Arlington, Va. A third station of the high-power type will be completed at San Diego within t e next six months, while contracts have been let for two others—one in the Hawaiian Islands and one in the Philippines. These new stations are being constructed along the most modern lines. It is believed that they will have a much wider range of communication than any others in the world, and their completion will put the United States distinctly ahead of any other nation in radio equipment.

Why not improve your electrical education? Read *The Electrical Experimenter* every month.

The Tesla High Frequency Oscillator

By H. Winfield Secor, E.E.

TESLA, probably the highest authority in high frequency electrical engineering to-day, has not been dreaming these past few years, although we have not heard much from him, except through the daily newspapers, which now and then publish some world-startling interview describing a "marvelous" Tesla wave with which it is possible to communicate with Mars and several hundred other astounding stunts that the winner of the Noble physics prize probably never even thought of, much less attempted to accomplish.

Most of our readers have, no doubt, seen pictures of the famous Tesla wireless tower located at Shoreham, Long Island, and which structure has involved the expenditure of a vast sum of money. From this lofty structure, which was designed in the neighborhood of 20 years ago by Dr. Tesla and his associates, there was to be propagated an electric wave of such intensity that it could charge the earth to such an extent that the effect of the wave or charge could be felt in the utmost confines of the globe.

Our front cover illustration shows the Tesla tower in (theoretical) operation and, in line with some of the latest statements from this marvelous man, there may be perceived several dreadnoughts being blown to atoms, which is due to the high tension electric wave sent out from this center of vast electrical activity. Tesla, for obvious patent reasons, does not go into details just how whole fleets of a hostile navy can be destroyed in this way by means of powerful electric waves, but quite possibly he has in mind the fact that the latter can be tuned, undoubtedly, to a particular wave of certain frequency and power to accomplish this result when liberated from such a mighty station or oscillator as that located on Long Island. Such ships as the great steel shell dreadnoughts of to-day would, of course, have a large electrical capacity and this would help out the Tesla theory which covers the transmission and reception of an electric wave of sufficient intensity to do great good or damage, as the case might be.

The illustration on the front cover of this issue shows future possibilities which may be developed on the Tesla theory as a foundation. The location of the oscillator tower, from which the electrical energy is transmitted, and also the position of the war vessels being blown up are not to be considered literally in the way they are here shown. As a matter of fact, the enemy could soon shell the tower down.

Fig. 1. Probable Appearance of the Wonderful Tesla Oscillator Tower at Night—It Is Located at Shoreham, L. I., and Is Intended for Radiating Electrical Energy in the Form of High Frequency Waves Propagated Thru the Earth Itself—Tower Stands 185 Feet High.

and hence it becomes evident that if this system is ever perfected and applied practically, the elevated radio energy transmitting station will have to be placed at a considerable distance inland. Again, as this wireless energy can be transmitted hundreds and even thousands of miles without any appreciable loss, according to Tesla's beliefs and statements, no disadvantage or inefficiency would be incurred by so locating the tower away from the coast; but conjointly, on this theory, the invading fleet of war vessels could be destroyed when they were still several hundred miles off shore. Hence, it would be impossible for them to hurl projectiles this distance. Also presumably this method of detonating the powder magazines of the war vessels could be applied to similar containers of high explosives on land, such as those carried by the heavy artillery corps of an invading army.

Further, it may be said that Tesla, all in all, does not believe in the modern Hertzian wave theory of wireless transmission at all. Several other engineers of note have also gone on record as stating their belief to be in accordance with Dr. Tesla's. More wonderful still is the fact that this scientist promulgated his basic theory of *earth current* transmission a great many years ago in some of his patents and other publications. Briefly explained, the Tesla theory is that a wireless tower, such as that here illustrated and specially constructed to have a high capacity, acts as a huge electric condenser. This is charged by a suitable high frequency, high voltage apparatus and a current is discharged into the earth periodically and in the form of a high frequency alternating wave. The electric wave is then supposed to travel through the earth along its surface shell and in turn to manifest its presence at any point where there might be erected a similar high capacity tower to that above described.

A simple analogy to this action is the following: Take a hollow spherical chamber filled with a liquid, such as water; and then, at two diametrically opposite points, let us place, respectively, a small piston pump, such as a bicycle pump, and an indicator, such as a pressure gauge. Now, if we suck some of the water into the pump and force it back into the ball by pushing on the piston handle, this change in pressure will be indicated on the gauge secured to the opposite side of the sphere. In this way the Tesla earth currents are supposed to act.

The patents of Dr. Tesla are basically quite different from those of Marconi and others in the wireless telegraphic field. In the nature of things this would be expected to be the case, as Tesla believes and has designed apparatus intended for the *transmission of large amounts of electrical energy*, while the energy received in the transmission of intelligence wirelessly amounts to but a few millionths of an ampere in most cases by the time the current so transmitted has been picked up a thou-

sand miles away. In the Hertzian wave system, as it has been explained and believed in, the energy is transmitted with a very large loss to the receptor by electromagnetic waves which pass out laterally from the transmitting wire into space. In Tesla's system the energy radiated is not used, but the current is led to earth and to an elevated terminal, while the energy is transmitted by a process of conduction. That is, the earth receives a large number of powerful high frequency electric shocks every second, and these act the same as the pump piston in the analogy just cited. These electrical impulses or shocks given to the earth are to be picked up at receiving stations by erecting a suitable capacity in the form of a metallic tower, as will be described more in detail hereafter.

Quoting from one of Tesla's early patents on this point: "It is to be noted that the phenomenon here involved in the transmission of electrical energy is one of *true conduction* and is not to be confounded with the phenomena of *electrical radiation* which have heretofore been observed, and which, from the very nature and mode of propagation, would render practically impossible the transmission of any appreciable amount of energy to such distances as are of practical importance."

He states further: "From my experiments and observations I conclude that with electromotive impulses not greatly exceeding 15,000,000 or 20,000,000 volts, the energy of many thousands of horse-power may be transmitted over vast distances, measured by many hundreds and even thousands of miles, with terminals not more than 30,000 to 35,000 feet above the level of the sea; and even this comparatively small elevation will be required chiefly for reasons of economy, and if desired it may be considerably reduced; since, by such means as have been described, practically any potential that is desired may be obtained and the currents through the air strata may be rendered very small, whereby the loss in the transmission may be reduced. It will be understood that the transmitting as well as the receiving coils, transformers, or other apparatus may be in some cases movable—as, for example, when they are carried by vessels floating in the air, or by ships at sea."

Tesla is not an idle dreamer, as many men are inclined to believe, but back in the year 1898 he succeeded, in some very elaborate tests carried out in Colorado, in producing high frequency electrical discharges, the like of which had never before been witnessed by man, nor have they been duplicated since, to our best knowledge. Some of these sparks measured 100 feet in length and produced a roar like the Niagara Falls. The multitude of mighty sparks and flashes produced a discharge so terrific that no human being could stay in the building in which they took place. Some of the sparks were as thick as a man's arm and others manifested even greater intensity. They were produced by a gigantic Tesla high frequency coil with which experimenters of to-day are more or less familiar in a small way. About 300 kilowatts were utilized in producing these discharges, which resembled actual lightning bolts and not imitation ones. The amperage measured 800 and the voltage was up in the millions. The illustration of these sparks, as well as Tesla's early work along this line, have been covered in previous issues of *The Electrical Experimenter.*

Regarding the Tesla tower on Long Island and the general engineering features of same, we may refer to his patent which covers the design of the high frequency apparatus of mastodonic design and capable of charging the structure at several million volts pressure. The external appearance of the Tesla generating plant and antenna support (185 feet high) are shown

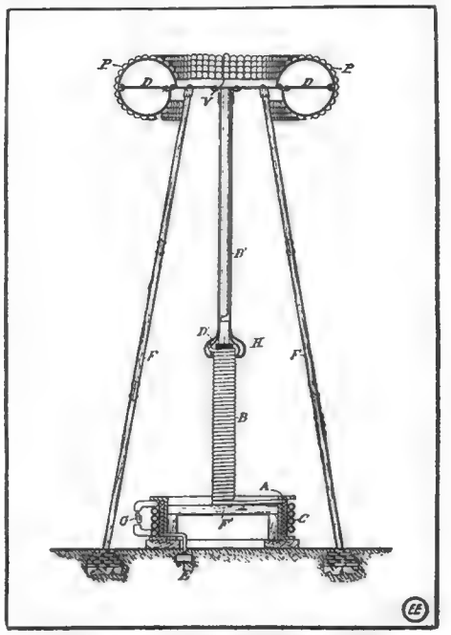


Fig. 2. Structure of the Tesla High Frequency Tower and Exciting Coils.

at Fig. 1. The huge high frequency step-up transformer is shown diagrammatically at Fig. 2.

Referring to this great structure which involves several peculiar design features, we see at the upper extremity a large capacity, D. This is made up of a metal framework upon which there is mounted a vast number of hemi-spherical metal electrodes. These are advocated for the reason that the minimum electrical leakage will then ensue. As points, of course, discharge any high tension current as rapidly as possible, they are done away with, as this is exactly what Tesla does not desire to have take place in this instance. The complete electrode comprises a suitably shaped metallic ring and the half-spherical electrodes appear at P P. Hence, within a reasonably small space an extremely large electrical capacity is formed. This capacity rests upon insulating supports, which in turn are well insulated from the earth.

The high frequency exciting circuit comprises a massive coil, A, which is in close inductive relation with the primary winding C, one end of which is connected to a ground plate, E. The other end of the coil is led through a separate self-induction and auto-transformer coil, B, and the metallic cylinder B^1 to the terminal D. At

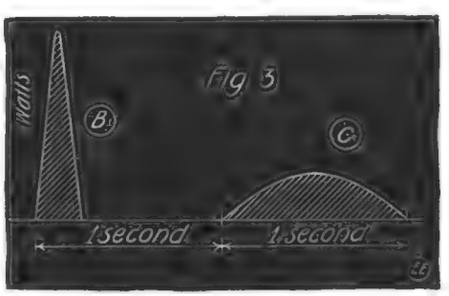


Fig. 3. Diagram Showing How the Rate at Which Energy Is Dissipated Increases as the Time Element Decreases.

the apex of the mast the connection with D is to be made at or near the center, Tesla specifies, in order to secure a symmetrical distribution of the current. Otherwise, when the frequency is very high and the flow of large volume, the performance of the apparatus might be impaired. The primary C is excited in any desired manner, from a suitable source of current G, which may be an alternator or condenser, the important requirement being that the resonant condition is established; that is to say, that the terminal D is charged to the maximum pressure developed in the circuit.

The adjustments should be made with particular care when the transmitter is one of great power, not only on account of economy, but also in order to avoid danger. It has been shown that it is practicable to produce in a resonating circuit as E A B B D immense electrical activities, measured by *tens and even hundreds of thousands of horsepower,* and in such a case, if the points of maximum pressure should be shifted below the terminal D, along coil B, *a ball of fire* might break out and destroy the support F or anything else in the way. An induced earth current out of phase with a "tower capacity" current meeting at any point along the coil, etc., would buck each other and so balls of fire could be produced; the instantaneous value of the energy so involved being truly astonishing. For the better appreciation of the nature of this danger it should be stated that the destructive action may take place with inconceivable violence. This will cease to be surprising when it is borne in mind that the entire energy accumulated in the excited circuit (instead of requiring, as under normal working conditions, one-quarter of the period or more for its transformation from static to kinetic form) may spend itself in an incomparably smaller interval of time, *at a rate of many millions of horsepower.* The accident is likely to occur when, the transmitting circuit being strongly excited, the impressed oscillations upon it are caused, in any manner more or less sudden, to be more rapid than the free oscillations.

It may seem quite impossible for many of our readers to comprehend the large figures cited by Tesla with regard to the voltage and horsepower liberated or propagated from such a structure as he has designed. However, by referring to Fig. 3, this matter can be more readily understood. This diagram shows how a graphic curve, C, would appear for, say, 100 horsepower liberated or passing through a circuit for the time period of one second. Now consider that instead of this 100 horsepower of energy being allowed to pass along in normal fashion for a period of one second, that it is heaped up or liberated in about one-fifth of a second as at B. The horsepower or watts, let us say in this case, would be dissipated at a much higher intensity rate than was the case at C. In other words, the rate of dissipation in this instance would be 500 horsepower for one-fifth of a second instead of 100 horsepower for one second.

Now consider that a Tesla current as produced by an oscillatory discharge from condensers and the like take place in very small fraction of time, then Tesla's statements in his patent and aforementioned with regard to the production of hundreds of thousands of horsepower is not so fallacious at it may seem. In an interview with one of our editorial staff he has vouchsafed the information that the oscillator here pictured is supposed to be excited with an input of 300 kilowatts. The average person then begins to gasp for air. An input of only 300 kilowatts! How, then, could this tower be caused to oscillate and liberate energy at the rate of hundreds of

(*Continued on page* 663.)

Electricity Wonderful Aid to Modern Surgery

THERE have been various improvements made in surgical instruments in the past few years, and the apparatus described here is the final result of extensive experiments and painstaking labor on the part of specialists to evolve a device that would simplify operations on bones.

Heretofore an operation which necessitated the sawing or cutting of bones was more or less clumsily done, due to the fact that the instruments entirely suitable for this purpose were not to be had and the surgeon did the best he could with those at hand.

The surgeon of to-day, however, is equipped with a unique instrument for this work in the way of an electrically operated bone set, which is shown in Figs. 1 and 2. The outfit comprises a source of power, in this case taking the form of an electric motor made of very light material, a foot switch for controlling the motor and various attachments as shown in the illustration. They consist of a selection of various small drills, saws and cutters, and are all interchangeable. They are held in place by an automatic catch built in the motor shaft. A specially made angular twin saw is provided with this outfit and is used for very deep wounds.

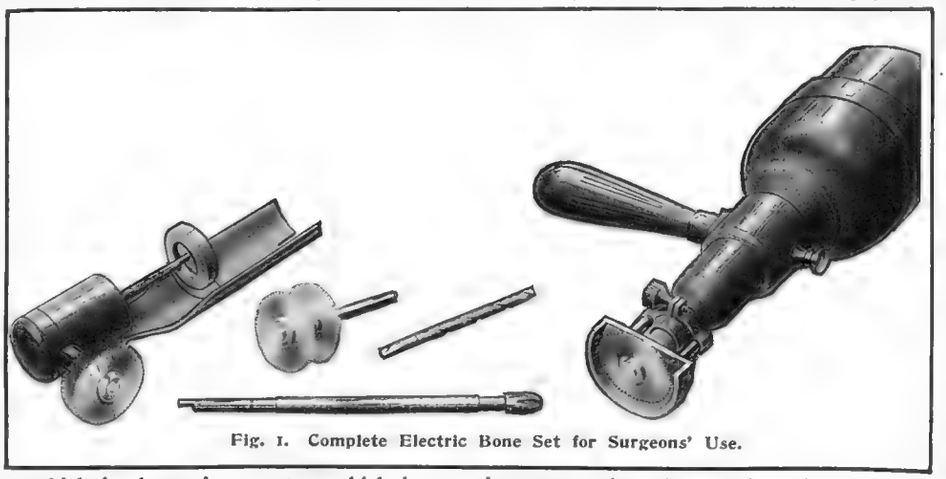


Fig. 1. Complete Electric Bone Set for Surgeons' Use.

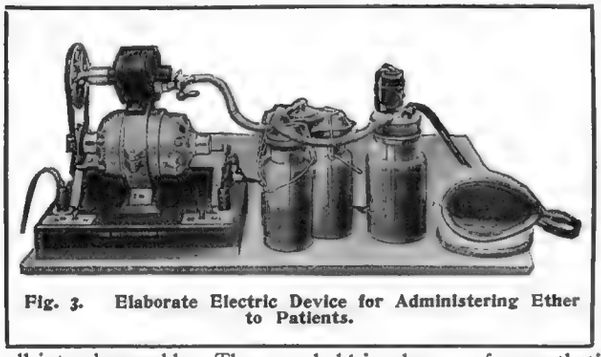


Fig. 3. Elaborate Electric Device for Administering Ether to Patients.

The fact that these attachments can be so rapidly changed is of great value to the surgeon, as he can change from one to another almost as quickly as he could select an instrument from the table. Time is an important factor in any operation, as the faster the work is done the less danger there is of fatal results. Besides being very light and comfortable to handle, the motor used is very powerful. The apparatus as a whole is easily sterilized and thus reduces the liability of infection to a minimum.

The motor being specially designed for this work has several refinements not found in other small motors of a similar type. The most noticeable of these improvements is the way in which the flexible cable is connected to the apparatus. Formerly this flexible cable has been of more or less trouble, due to the fact that it often became heated and stalled the motor. In this design such trouble is done away with entirely.

The current to the motor is run through the foot switch previously mentioned and, as the name indicates, the latter is operated by the pressure of the foot. With this type of switch the surgeon had at all times perfect control over the speed of the motor, which is very important when the different attachments are being used.

With this bone cutting instrument bone grafts and their recipient beds can be speedily and accurately made with a minimum expenditure of time and work, with the consequent lessening of the danger from infection which contributes to the ultimate success of the operation.

Of the utmost importance to modern surgery is the method of administering the anaesthetic. In days gone by, when the surgeon was compared more or less to a "butcher," the usual manner of anaesthetizing the patient was to place a piece of cotton over his nose and mouth and then pour the anaesthetic, chloroform or ether, over the cotton. The vapor therefrom was, of course, inhaled by the patient with the desired results.

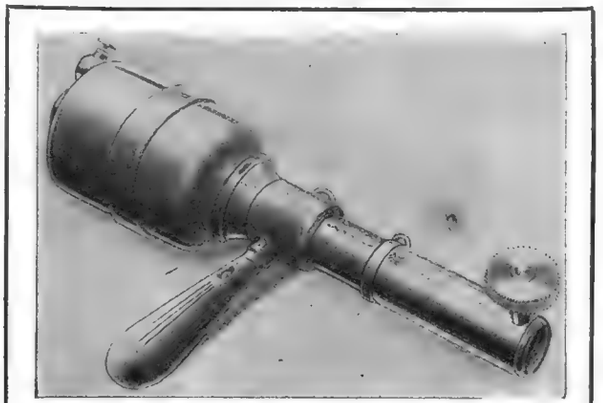


Fig. 2. Closer View of Electric Motor and Special Tool Chuck Used for Bone Operations.

This method was improved upon by the use of a mask which was placed over the face. It had a receptable at the top in which gauze or cotton was placed. The liquid was poured on and the vapor, of course, inhaled with resulting unconsciousness.

There were drawbacks even to this method, and physicians started experimenting with apparatus that would simplify this part of the operation. Several schemes were worked out, but none possessed the great efficiency or ease of manipulation of the appliance illustrated in Fig. 3. This apparatus consists of four units: 1. A motor blower and rheostat. 2. Ether or chloroform container. 3. Mercurial manometer registering from 5 to 50 mms. and capable of being easily set for any operation and acting thereafter automatically. 4. Hot water for adding both heat and moisture to the vapor. Another form of an etherizing machine is depicted in Fig. 4.

The apparatus shown at the right is used for administering the gas to the patient. The mask is adjusted over the face, and the amount of ether to be given is placed in the vaporizing chamber. As soon as the heat is applied the ether is quickly vaporized and forced into the patient's lungs by means of the blower.

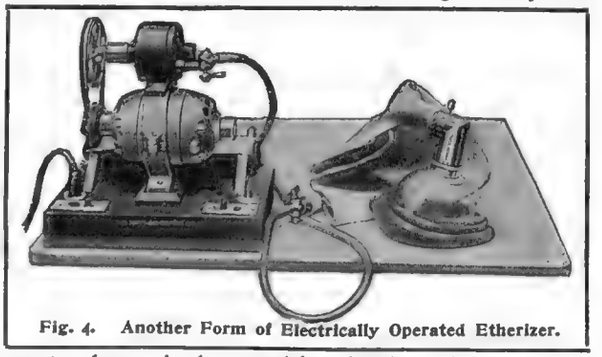


Fig. 4. Another Form of Electrically Operated Etherizer.

GREAT FUTURE FOR X-RAY.

The results already achieved by the X-ray in combating ills are only a hint of ultimate successes expected, specialists recently told the annual convention of the American Roentgen Ray Association. Dr. W. D. Coolidge, of Schenectady, N. Y., said that the investigators were dealing with the future and not so much with present attainments, because they saw tremendous discoveries clearly ahead within striking distance.

He spoke of the need of standardization and checks upon manufacturers of the apparatus used, and asserted the belief that it will be as simple a matter to standardize the equipment of X-ray specialists as it was the incandescent lamp. Experiments had shown, he said, that it was possible to get one-third more radiating energy with the direct current than from the alternating current and to vastly increase the intensity of the ray with the aid of revolving targets.

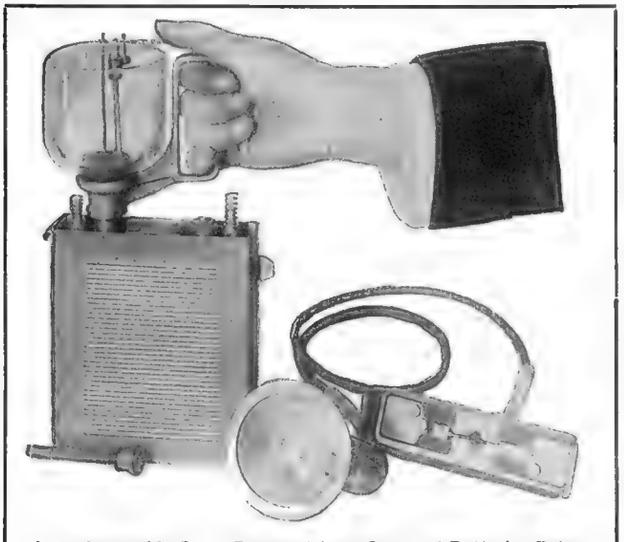
Edison Perfects Storage Battery Miners' Lamp

The latest device brought out by the Edison laboratory is a highly perfected storage battery miners' lamp. This is developed to the finest detail, and it has been considered so meritorious that it was awarded the Rathenau Medal of the American Museum of Safety. This medal is placed at the disposal of the above-mentioned museum by the Allgemeine Elektrizitäts Gesellschaft, of Berlin, to be awarded for the best device or process in the electrical industry for safeguarding industrial life and health. The Edison mine lamp was the first to receive this marked honor.

New Edison Battery Miners' Lamp in Use. The Angle of Illumination Is Well in Excess of the 130 Degrees Required by the Government.

The illustration herewith shows respectively the perfected Edison mine lamp in actual use down in a coal mine and the thumb actuated refilling device which is not only a great time and labor saver, but is also very cleanly in its action, preventing the spilling of the solution over the outside of the battery casing, etc.

The battery container holds two cells of the nickel-iron-alkaline type, and thus produces two and one-half volts. The elements, nickel hydroxide and iron oxide in a potash solution, are encompassed by a strong, nickel-plated steel container, hermetically sealed except at one small outlet for the escape of the harmless and odorless gases when being charged. The cell may be turned upside down without in any way proving disastrous to the miner or to the action of the battery. This is arranged for by the unique design of the ventilating tube, which prevents the escape of any of the solution, even though the cell be violently shaken. The cell fits snugly into a light outer casing, which is rustproof and made of monel metal. The battery is held on the miner's back or, rather, at his waist line by means of a leather strap passed around the body. An extra heavy flexible conductor leads up to the lamp, which is fastened on to the cap. The lamp is usually lighted when handed to the miner and they are generally charged in groups every night at a central charging room or station located at the mouth or the entrance to the mine. The battery case is secured by a padlock so that it cannot be tampered with. The whole outfit proves practically foolproof and as safe as any lamp available for the purpose.



Interchangeable Cover Removed from Case and Batteries Being Watered by Automatic Filler.

The automatic battery filler and "watering" gauge shown in the second illustration makes it possible for unskilled attendants to readily care for the batteries. It assures absolutely proper filling in every case when employed, as it not only indicates when the normal level of the battery has been reached, but it also automatically cuts off the flow of water at that point. It can likewise be used for renewing the alkaline solution.

NEW HIGH-CANDLEPOWER FLASHLIGHT.

A novel and useful flashlight has been perfected by George K. Burleigh, known as the Fire Fly Light. It has many new features as well as being very attractive. The case (Fig 1), which contains an ordinary dry battery, is enameled red, the fiber disc which covers the battery white, the handle blue. The two tungsten lamps are operated from one switch, and by mirror reflection triple the illumination given by any single battery light is obtained. It gives a diffused and not a concentrated light, so that by placing it in one corner of a small room you can read in any part of the room. Other new features are that if anything happens to one of the lamps you always have the other in use, and the U clip shown in the cut, which slides up between battery and battery case, can be screwed to the floor of automobile or carriage, in any safe place, and the light can be pulled off the clip instantly to measure gasoline, read signboards, make repairs around motor, et cetera.

Fig. 1. New Double Bulb Electric Lantern.

The second illustration shows the strap furnished with each light for hanging it around the neck, with battery buttoned inside the coat. This gives at all times the free use of both hands. In this way it is especially useful in looking after the furnace, for the farmer pitching down hay or milking cows, firemen rushing from one room to another and carrying occupants overcome by smoke, etc. The whole outfit weighs about four pounds.

Fig. 2. Triple Bulb Battery Lamp Strapped Around Neck. Excellent for Firemen and Others.

UNIQUE DIVING BELL TO HELP RAISE SUNKEN SHIPS.

A California inventor has perfected a submerging or diving bell formed of a single hollow steel casting, which is capable of accommodating an operator, and it is

A large Diving Bell Designed to Aid in Raising Sunken Vessels.

provided with powerful securing or retaining magnets, as well as electric searchlights and large glass windows, through which the submerged wreck may be inspected This salvage machine, if so it may be termed, is suspended on a steel cable from a tender ship on the surface, as our illustration shows. When the steel shell attains the proper position with respect to the sunken vessel, the electric current flowing through an insulated cable from the tender on the surface is thrown into the powerful electromagnets and the entire ball is held rigidly at that particular point against the hull of the vessel. A specially devised and controlled drill then bores a hole in the steel shell of the sunken ship and by an ingenious arrangement of screws on the outside of the salvage machine, the body proper of same can be moved several feet laterally or vertically, with respect to the holding magnets. After a hole is drilled, this permits the operator within the bell to manipulate a magnetized arm, which picks up one of the pontoon cables, as may be noted in the illustration. The end of this cable is fitted with an automatically locking toggle hook which is secured in the hole previously drilled. Thus the operation is repeated until all the pontoon cables are fastened to the hull of the boat.

These pontoons are fitted individually with electric motor-driven pumps, so that the water can be pumped out of same separately or all together simultaneously; in this way the vessel is supposed to be readily raised to the surface, when it can be towed to the nearest harbor or to shoal water for overhauling and repairs.

Such work as this is extremely interesting to a large class of people, as many of the stories of sunken vessels carrying vast amounts of gold are not mythological, but actual facts, and a great number of these wrecks, worth many millions of dollars, are definitely charted on the hydrographic maps of the Government. To reclaim such wrecks and the buried treasure thus lost has been the dream of untold numbers of inventors, and this device bids fair to accomplish some valuable work in this direction.

TELEGRAPHING OVER TELEPHONE LINES WITH SIMPLE DEVICE NOW POSSIBLE.

A patent has just been allowed to Paul P. Banholzer, of Philadelphia, Pa., on a mechanical telegraph instrument for telegraphing by wireless telephone and over telephone circuits. It is claimed that this instrument will further introduce the dot and dash system of telegraphy, which can be understood by any wire operator. Furthermore, the sound it produces is unmistakable and carries much farther than the voice.

For telegraphing over telephone lines the modified key here illustrated is clamped to the post of a desk telephone and when the key is manipulated the Morse code characters are received at the distant end of the circuit clearly and distinctly. The dots and dashes on the key are transmitted

Simple Key Attachment Enables You to Telegraph Over Any Telephone Line

mechanically to the diaphragm of the microphone through the metal stand parts and are transmitted over the line, as are voice currents, and reconverted into sound waves in the receiver at the other end. A desk telephone, with this device attached, can be "jacked" into any telephone circuit and used as an extension telephone. In this way the hinged fastener can be used anywhere without having to change the fastener or use bushings.

This instrument is stated to be an especially useful device in connection with telephone train dispatching, since the telegraph system could be used when telephone conversation is not understood or is otherwise difficult owing to bad weather effects on the line, etc.

It is claimed that this key could be used with advantage in branch telegraph offices where there is but one telegraph wire. Such offices, as a rule, have a telephone, and this circuit could be used to forward their messages without having to wait their turn on the telegraph circuit.

Quite a number of these instruments are in successful operation in the South and West, and reports indicate that they now form a part of the permanent equipment of those lines.

There can be no induction on parallel lines, as no additional battery is required to operate the instrument. What has been said in regard to the wire telephone system also applies to the wireless telephone system.

CARNEGIE SENT FIRST TECH. WIRELESS MESSAGE.

Andrew Carnegie sent the first message from the new wireless station at the Carnegie Institute of Technology, Pittsburgh, Pa., the most powerful in the State, and one of the largest in the country, when he attended Carnegie Day celebration, Nov. 23. The outfit is nearly twice as strong as the average outfit on United States battleships, and will send messages as far as Colon, Panama.

The Radio Club of 30 members installed the apparatus. The club is composed of Tech. students and wireless men of Pittsburgh. It has applied for membership in the American Institute of Radio Engineers.

ELECTRIC IRON MAKES INTERESTING PARADE FLOAT.

In line with the widely extended advertising campaign during "Electrical Prosperity Week" there were many parades and electrical demonstrations conceived and carried out to further the aims of this business-getting propaganda.

Among the very interesting floats and beautifully decorated autos that appeared in the various parades there was one that seemed to appeal to the public more than the rest. This resembled a gigantic sad-iron mounted on an automobile. The illustration herewith gives some idea of the appearance of this unique float. In one of these recent events held at Liberty, N. Y., the sad-iron float was selected as one of the best decorated of all the entries made.

Such decorated autos or wagons do not cost an exorbitant amount, and the one just referred to entailed an outlay of about $31. This is very low when the size of the float is considered, the over-all dimensions of the outfit having been 16½ feet long, 7 feet wide, and 9½ feet high. Muslin was used to make a smooth outline of the base of the sad-iron, being stretched over an under

A Flatiron Float that Can be Built for $31 or Less.

framework or skeleton made up of some light wooden strips. Storage batteries and low-voltage tungsten lamps enable some wonderful and spectacular effects of this nature to be attained at a nominal cost.

Electricity the Beneficent

By Benjamin G. Lamme

Chief Engineer Westinghouse Electric & Mfg. Company, and Member Civilian Naval Advisory Board*

THE benefits of electricity to mankind are so various and so far-reaching that it is difficult for any one person to fully appreciate them. These benefits are both direct and indirect, the latter sometimes far overshadowing the former. Many of the present generation are so accustomed to electrical appliances and methods that they do not fully perceive the large part such take in our daily life. It has been said that one cannot fully appreciate a thing until he has to do without it. This points to a very effective way of calling attention to the far-reaching influences of electricity in the life of the world.

Let us assume that by some means, all electrical apparatus, methods and usages are suddenly withdrawn from the world. By considering the consequences of this we can possibly get a fair idea of the scope of the electrical field.

IMAGINE, if you can, that when you awake to-morrow morning, the whole world will be suddenly without electricity in any of its present forms. Have you even a faint idea how it would affect your everyday life? What would happen if such a cataclysm should take place over night? How would it affect humanity? This is the theme of the present article selected by its distinguished author. It makes good reading and brings home to us the fact that the world in its present state is vitally dependent upon the mysterious fluid.

Let us consider first the general subject of transportation. Possibly no other activity has had as great a bearing on the present high development of mankind as our modern methods of transportation. Taking steam operation, wherein does electricity play an important or controlling part? Or, by a more specific question, supposing the electric telegraph were suddenly eliminated, how would general railway transportation conditions be affected? They would be completely disorganized temporarily, and would be very greatly handicapped permanently. Rarely is it appreciated to what an extent our great railway systems are conditioned upon means for almost instantaneous communication between distant points. Without such means a busy railroad could only operate upon an exact time schedule. Once that schedule is broken, disorganization and disaster would follow. Incidentally, someone will suggest that if the electric telegraph were eliminated, the railroads would turn to the telephone. But this again is an electrical apparatus.

A second great item in railroad transportation at the present time is electric signaling for the dispatch and control of trains. If eliminated, this would certainly mean a great step backward, especially in sections of very heavy and frequent railway service.

What would be the effect of complete cessation of electrical operation of city, suburban and interurban cars? In the cities we might go back to horse cars for the surface lines. The service would be almost unbearable, but might be possible. Elevated trains in large cities could go back to steam, however, with great objections from adjoining business firms and residents. But subways—here would be a real nut to crack.

In suburban service, the elimination of the electric car service would spell disaster, except to those relatively few individuals who could have their own equipages. How few appreciate that the rapid growth of suburban districts has been consequent upon electric railways. Autobusses and "jitneys," or some other form of gasoline engine equipment, might furnish a solution eventually, but then, how about the electric spark for ignition?

Again, let us consider interurban car service. No other means can faintly compare with the electric car systems in bringing the people of city and country together. Steam service, with its infrequent trains, did little in this direction. The figures giving the great growth of passenger traffic between country and city districts following electric car operation, tell a most interesting story.

Electric haulage in coal mines is now standard practice. Decrease in fire risks and increased capacity are two prime reasons which have led to electric operation. Eliminate the electric current and coal mining can doubtless be carried on with more or less success, but with decreased production and increased cost, which must be borne by the public. We can always go back to the old ways of doing things, but we will have to pay the price.

In water transportation electricity, perhaps, has not played such a conspicuous part as on land. Yet if the electric installations on ocean vessels were eliminated, there would have to be quite a reorganization. Electric propulsion of large and high-powered vessels promises to be one of the most important steps in naval engineering in the near future. Wireless telegraphy has become a necessity in modern sea service.

Taking up next our business and industrial life, let us imagine a few of the things which would happen if electricity were entirely eliminated. Without the telegraph, business would be very badly handicapped, although it might limp along after a fashion. But the telephone—here would be the rub, if we had to give it up. Whole systems of conducting business are dependent upon the telephone. Disorganization would be certain to follow in many lines if it were eliminated. Even home-life would be greatly affected.

Let us next consider the elevator. What has been its influences on life and business in the cities? How about the large many-storied department stores? Can anyone conceive of a practicable 20 or 30-story skyscraper without elevators? And one must remember that most of these elevators are electrically operated. True, there are other very good methods of operating them, but nevertheless, the elimination of the electric elevator would make a large gap in our methods of vertical transportation.

This leads us to a very common piece of apparatus, namely, the electric motor. This has come into use so gradually, and with so little ostentation, that we almost feel that it has always been with us. Yet, in less than one generation, it has revolutionized all kinds of manufacturing establishments and industries. Take the electric crane for instance, what would the great industrial works of the present time do without this particular application of the electric motor? Take the use of electric motors in general throughout such establishments. How would the necessary power be distributed over the vast areas of modern manufacturing plants if electricity were eliminated? Possibly a way could be found, but in most cases it would require a complete reorganization of many of our present industrial methods, and efficiency would take a long step backwards.

In the smaller shops and power applications, the electric motor fills a fully as important place. Small steam plants are utterly impracticable in some places. Gas or gasoline engines are often very objectionable, but still possible. But how about the electric spark for ignition, if electricity is to be eliminated? It must also be kept in mind that many establishments using power have been so designed that the replacement of the electric motor by any form of steam or gas engine is not practicable for many reasons outside the mere question of ability of the latter to develop the required power. Available space, high temperatures, fire risks, disposal of burnt gases, noise, and many other conditions enter into this matter.

Outside of shops and industrial plants, the electric motor also has a very wide field of application, and many kinds of service have developed simply through the availability of the electric motor as a source of power. This part of the subject is too large to allow consideration in detail in any article of limited scope.

Coming now to one of the oldest and best known fields of electric activity, namely, electric lighting, we find a class of service the abolishment of which would be felt by all classes in civic life. If electric street lighting were abandoned, we could doubtless manage with some other form of illumination, but the results probably could never approach the present standard. In the case of interior lighting, the result of a replacement of the incandescent lamp by other forms of illumination would create still more dissatisfaction than in the case of street lighting. It may be said that the vast majority of electric light users would pay a greatly increased price rather than be obliged to give it up in favor of any other known method of illumination.

Another class of electric service of a comparatively recent period is represented by household utilities, such as electric irons, toasters, coffee percolators, and other electric heating appliances. Motors for general household purposes, for running sewing machines, washing machines, etc., are becoming rather common. These are luxuries which are fast becoming necessities. If these were eliminated a big gap would be created, even though they represent a comparatively new field of application.

The above is only a very incomplete presentation of the direct possibilities which would occur in case there was a complete cessation of all electrical activities. Many of the special applications of electricity such as electro-chemical, electro-metallurgy, electro-fusion, etc., have not even been touched upon, and yet great industries have been built upon them. The

(*Continued on page* 656.)

* Prepared exclusively for The Electrical Experimenter.

GEORGE SIMON OHM. MARCH, 1916, MARKS HIS 128TH BIRTHDAY.

(Born 1787—Died 1854.)

In 1827 Dr. George Simon Ohm, a German physicist, rendered a great service to electric science by his pamphlet containing his theories that the flow of electricity was governed by certain fixed laws. It explained what is accepted and known to-day as "Ohm's Law," and the "Ohm" is now universally employed as the unit of resistance in an electrical circuit. This law states that *The current varies directly as the electro-motive-force, and inversely as the resistance of the circuit.* Like all great inventors, Ohm was ahead of his time, so his ideas were ridiculed by great and small.

He was the son of a thrifty locksmith, of keen intelligence, and was born March 16, 1787. George Simon Ohm started his career in the village of Erlangen, Bavaria, as a helper in his father's shop. He inherited a love of mathematics from his father, a man of studious disposition. The parents early recognizing the latent talent in their son, accumulated enough money to send George to college. Owing to lack of funds, he was compelled to forego his schooling a few years later. He then reluctantly turned to teaching in a primary school.

George Simon Ohm, After Whom the "Ohm," Unit of Resistance, Is Named.

This sudden financial stress did not daunt the young locksmith student one bit. He filled in most of his spare moments studying, but it must not be thought that he gave up all outdoor pleasures. Unlike Ampère, he was popular among the students and professors and joined in all the social life and athletic games.

In 1817 George Simon Ohm was appointed professor of mathematics in the Jesuit Gymnasium at Cologne. The following year he published his famous "Elements of Geometry." He resigned a few years later and went to Berlin, where he became interested in electrical experiments. Ohm then pushed his researches in the footsteps of Galvani and Volta, the results of which were embodied in a pamphlet called "The Galvanic Circuit."

About 14 years after publishing his theories, when he was in the midst of his wonderful career, Ohm was awarded the Copley medal by the British Royal Society in 1841. For a time thereafter professional jealousy reduced Ohm to a condition of comparative poverty, but regardless of this he continued the course of his investigations. The International Congress of 1881 gave Ohm's name to the unit of electrical resistance, and so his name came to be one known to all electricians in every part of the globe. Wherever you find the volt chasing the ampere around the circuit, there also will you encounter the "ohm," who bucks their onward rush with all the strength he possesses. Ohm's law written algebraically, $C = \frac{E}{R}$, has been adopted as the emblem of the National Electric Light Association, one of the most powerful scientific organizations extant to-day.

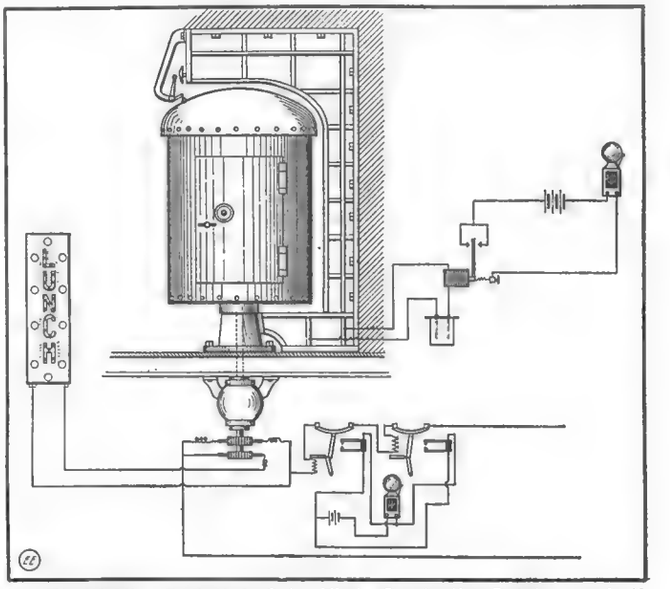
Electricity Renders Safe Impregnable.

By George C. Denny.

Electricity, the adroit crook's most formidable enemy, is forever beating him at his own game. It moves silently and quickly, strikes when least expected and, landing him behind the bars, prevents him from obtaining his much-desired haul. In a revolving safe, the subject of a recent patent, which appears to be the latest invention for foiling the expert cracksman, the unknown medium plays the leading role. By continuously turnning the safe, which may be made still more impenetrable and secure by placing it in an enveloping sheath, electricity will render his drills and other tools of this class ineffective against it and, moreover, prevent the use of an explosive as by pouring it in the cracks in the safe or in a hole bored for that purpose, as is usually done. The motion of the safe and sheath, too, will attach to it so many uncertainties that the ambitious yeggman who might smilingly tackle the job, were the safe at a standstill, would soon turn away for an easier one with less risk.

That the motion of the safe may not be slowed down or stopped, over-load and under-load cut-outs are provided which are acted upon by the motor which turns the safe and which runs at a regular and predetermined speed. When one of these cut-outs is placed in action by an over- or under-load on the motor, a signal is promptly given that the safe is being tampered with.

To indicate the position of the safe door a bell mounted in a certain place on the sheath is struck, or a light placed in the proper position energized when the door has made a complete turn. These devices become necessary when the safe is placed in a niche in the wall or surrounded by a lattice work, as shown in the illustration. This manner of placing the safe effectively prevents its motions from being followed and the safe or sheath from being worked upon. The lattice work is also wired, so that any tampering with this structure would cause the sounding of an alarm.



An Electrically Protected Safe That Constantly Rotates, and If Tampered with Gives a Code Signal on the Sign Outside the Building.

A street sign with a number of lights, secretly wired to the safe and placed outside, would, by the alternate lighting of the lamps, caused by a commutator on the motor shaft, inform a watchman that the safe was intact at the completion of each revolution. Another novel method of protection would be to place the safe in a window, and the revolving thereof, besides attracting attention and acting as an advertisement, would insure the safety of its contents.

CLASSIFIED!

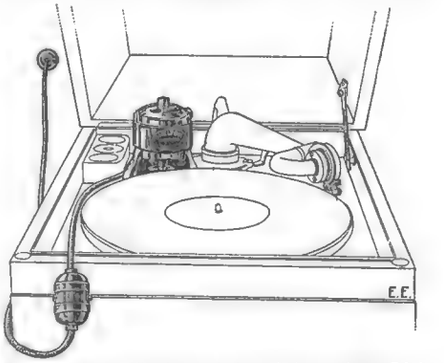
The applicant for the post of second wireless operator seemed somewhat dense, but otherwise appeared to be a clean-cut chap.

"I suppose you are a single man?" asked the port operator during the conversation.

"Er—er, no, sir," he stammered; "I'm twins."

A MOTOR THAT OPERATES ANY DISK PHONOGRAPH.

One of the latest electrical motor productions brought out by a New York concern appears to solve a very important problem which has long confronted the owners of a Victrola or other disk-type talking machine. This motor, which sells at a nominal price, does not have to be attached or screwed fast to the cabinet of the talking machine in any way, but simply rests on the shelf of same. On the lower end of the motor shaft is secured a friction pulley, which by frictional contact with the disk platen of the phonograph drives it at the proper speed. The regulator on the talking machine can be employed in the usual way for varying the speed of the record.



This Unique Electric Motor Drives Any Disk Style Talking Machine. Does Not Mar the Cabinet.

RADIO AMATEURS TO RELAY MESSAGE OVER U. S. ON FEB. 21.

Another radio M. S. G. (message) will be relayed from Rock Island Arsenal, Illinois, on Feb. 21. This radiogram will be delivered to 9 X.E. by the U. S. Army officer in charge of the arsenal station.

Owing to the fact that Feb. 22 is Washington's Birthday the message will be partly military in nature and also in keeping with the spirit of the day, which is dear to the heart of every loyal American.

It will be sent out on a Q. S. T. by many stations—special and amateur. It will be up to the many stations listening in to pick up the M. S. G., as the list of sending stations, their time and wave length will be given in the final instructions.

Each Governor and Mayor of every State throughout the United States will receive this message. Arrangements have been completed with the Boy Scouts of America to assist in delivering it wherever possible, and suitable ceremonies will be held at Bunker Hill and Mt. Vernon by these coming citizens of the U. S. A.

Valuable assistance has already been given by the various local and national radio clubs. The A. R. R. L. have promised their assistance. Every wireless amateur in the country is requested to "talk" this over with his favorite relay station. Telegram blanks will be furnished each receiving station later by 9 X.E.

N. A. A. (Arlington) has promised to assist in this great undertaking, the same as it did during the Rotary relay message sent broadcast on Dec. 31 last, by sending out a warning to all amateurs to "keep out," after the N. A. A. routine report of Feb. 21, 1916.

We all owe our thanks to Capt. Bullard, who has given us every assistance. All are requested who may be assigned the delivery of this message in their respective States or cities to deliver it, no matter where your man may be. Yours is a perfectly legitimate mission and you have no cause to fear anyone—just land your man and give him the telegram.

Yours for a great success, 9 X.E.

[*The Rotary M. S. G. of Dec.* 31, 1915, *was received in Texas and Utah. All States between these received the radiogram. Also Niagara Falls to Washington, D. C., and all cities between received it.*]

UNIQUE ELECTRICALLY LIGHTED TRAFFIC SIGNS.

The accompanying illustration depicts

Mt. Vernon, O., Makes Use of Portable, Electric-Lighted Traffic Signs.

the unique and also inexpensive form of electrically lighted traffic signs which have been erected at the four entrances to the public square of Mt. Vernon, Ohio. As noted from the illustration, these signs read, "Keep to Right." These words are visible to traffic in either direction, both night and day. At night there are two 25-watt tungsten lamps suspended from brackets above the sign on either side of same, so that it can be read at a considerable distance.

The upright standards supporting the sign and tungsten lamps are constructed from 1-inch conduit. Above the lamps there extends a 10-foot piece of ¾-inch conduit, through which the feed wires for the lamps are run. These wires are connected with the over-head 110-volt circuit.

Prior to the erection of these signs, which, by the way, may be moved about, it was necessary to keep two or three policemen on duty at the center of the intersections in order to prevent collisions.

President Wilson 'Phones Message to Boys' Club

The Boys' Club, located in New York City at Avenue A and Tenth street, had what might be called, without a doubt, a "large size" evening on Jan. 17 last, when over 200 newsboys who were campaigning for a half-million-dollar fund for the erection of clubhouses listened to a talk by President Woodrow Wilson in the White House at Washington through the medium of a long-distance telephone and a number of multiple receivers.

Photo: Copyright by International Film Service.

At the Boys' Club, New York City, When President Wilson Talked to Them Over the 'Phone from Washington.

The boys were so delighted by the President's words of encouragement that they cheered him to an echo over the 'phone, and he was highly pleased by this ovation. The lads who heard the President had been invited by the club from the streets of the East Side of New York; many of them were newsboys with hands blue from the cold, with torn clothing and heavy, ill-fitting shoes. They were gathered behind desks arranged in a large square in their gymnasium, their begrimed faces glowing with the enthusiasm of the moment, their hearts beating furiously as they listened for the first words of the President's talk. All of these boys are to be beneficiaries of the campaign carried on to raise the sum of $500,000 for new clubhouses in Greater New York.

This was the President's address: "I am very glad to have this opportunity to address a few words to the boys. I hope with all my heart that you will have success in raising this fund to be devoted to the youth of America. I hope this may be only the first of the signs of friendship that all ought to feel for the boys who bring us our papers. My sympathy has always been with the newsboys. Please give them all my very best wishes."

Behind the boys who held the receivers were several hundred other members of the club. The smallest lads were given the preference at the receivers, but while the President spoke many receivers were passed back into the crowd to give others an opportunity to hear. The doors of the clubhouse were closed and locked at 8 o'clock. Outside the street was black with youngsters who could not gain entrance. They took the cheering up after the President had talked and for several minutes Avenue A was filled with lusty shouts, the like of which had not been heard in that locality in many a day.

Long live the telephone, the annihilator of distance and the gift of science to mankind which has made it possible for gatherings such as this to hear and enjoy a speech by such men as President Wilson, although they may be located hundreds or even thousands of miles away. It is now a common occurrence for club diners in New York to listen to speeches made in San Francisco, and vice versa. For these occasions special equipment is installed by the local telephone company, including a sufficient number of multiple receivers, so that each guest can hear the speech.

NEW WIRELESS TO ALASKA.

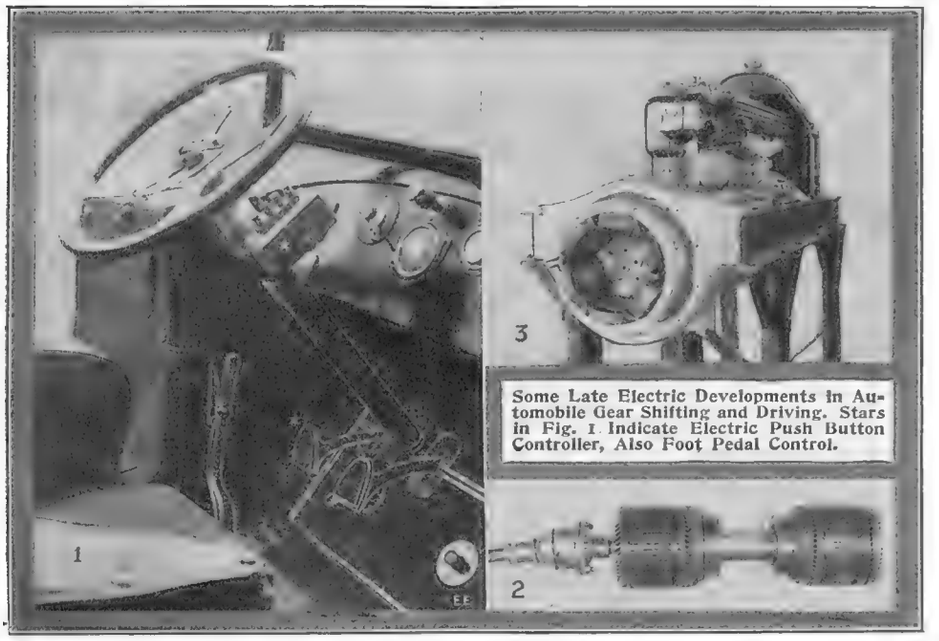
For years the only telegraphic communication with Alaska has been by way of the Sitka-Seattle and Valdez-Sitka cables. The growing commerce between Alaska and the States has resulted, as stated by H. Brown, commercial superintendent of the Western Union Co., in the establishment of an alternate wireless route by way of Astoria, Ore., which furnishes a telegraphic connection with a number of important points in Alaska.

Why not become a regular reader of *The Electrical Experimenter?* Subscribe to-day! It will cost you but $1. Do it *now.*

Electricity Fills Important Rôle in Modern Automobile

THE automobile of to-day is rapidly coming to the point where everything in the operation of same will be controlled by a series of push buttons. We light the headlights, start the motor, or blow the horn by merely pushing the proper button, and now by means of the device illustrated at Fig. 1 we even shift the transmission gears. Instead of the usual wrist strain and noisy grating of the gear teeth that used to accompany any change of speed we merely select our speed, push the button and a touch of the clutch pedal does the rest.

This system is operated entirely by electricity and all the gear shifting done in the gear case by means of magnetic solenoids energized from a storage battery. Each of the solenoids is connected to its respective control button, mounted on the steering column, and a master switch is controlled by the clutch foot pedal. The switch here illustrated has three speeds forward and one reverse, which is sufficient for most ordinary work.



Some Late Electric Developments in Automobile Gear Shifting and Driving. Stars in Fig. 1 Indicate Electric Push Button Controller, Also Foot Pedal Control.

The operation of this apparatus is as follows: When the proper button is pushed it closes the circuit to the solenoid, which will throw the gears into the required position. The clutch pedal is depressed and when released closes the master switch, which throws an enormous current into the solenoid for a mere fraction of a second. The change of gears is accomplished so quickly that they mesh cleanly without a clash or any damage. This saves both the driver's temper and the cost of stripped gears.

It will be thought that nothing more could be devised in connection with the gear transmission, but in Figs. 2 and 3 we show a transmission mechanism which does away entirely with the necessity of a gear shift and yet gives a finer regulation of speed. R. M. Owen & Co., to whom we are indebted for the illustrations, call their car when equipped with this device "The Car of a Thousand Speeds."

This system of electrical transmission is as unique as it is flexible and consists of a generator, motor, storage batteries, resistance coils and controlling switches. The generator field is rigidly connected to the crank shaft as shown in Fig. 3, and the armature is connected to the driving shaft. The motor field is stationary and its armature, like that of the generator, is rigidly connected to the driving shaft as illustrated in Fig. 2. Thus it is evident that the generator field is revolved at engine speed, and both generator and motor armatures revolve at wheel shaft speed. The motor and generator are direct current machines; the motor being series wound, while the generator is shunt wound. This arrangement necessitates the revolution of the generator brushes at the same speed as the field. In order to deliver current to the brushes of the motor they are connected to slip rings, this same device being used for making connections with the field.

The complete system operates as follows: For cranking the generator is energized by current obtained from storage batteries, causing it to act as a motor, thus starting the engine in the same manner as the commercial motor starter now extensively employed. For starting the car a resistance is connected across the field of the generator, and as the magnetic flux builds up the field exerts a *torque* on the armature and turns the driving shaft and consequently starts the car. The resistance in the field is then cut out and short circuited, thus more current flows in the fields increasing the flux and exerting a greater torque on the armature which accelerates the car. The generator is constantly producing current due to the difference in speed of its field and armature. This current is led into the motor, which exerts a torque on the driving shaft and helps the generator to drive the car. To further increase the speed resistance is switched into the motor circuit, thus throwing more current through the field of the generator, which thus tightens its grip on its armature and decreases the *slippage* between the armature and the field. Successive resistances are cut in until practically there is no current drawn from the generator. The motor is then cut out of circuit and the generator armature feeds the fields only. The generator now acts as a magnetic clutch, the current necessary to energize is produced by a slight slippage between its armature and field which amounts to about 10 per cent. This slippage is sufficient to generate enough current to transmit 40 or 50 horsepower through the apparatus with high efficiency.

This may not seem possible, but it must be remembered that the slippage between the generator's field and armature has been decreasing as the car is accelerated, so that the relative speed of field to armature is small when this connection is made. With this small relative speed the armature reaction is not great enough to break down the torque. In this condition a point of equilibrium is reached where the slip is just sufficient to generate enough current to maintain the magnetic grip. The operation is analogous to that of the induction motor, in that an increase in load is balanced by an increase in slippage. If a grade is encountered the slip increases and because of this a greater torque is exerted on the driving shaft, due to the additional current generated.

All these operations are controlled by an extra lever situated on the steering wheel, thus eliminating the clutch pedal and gear levers. There is no flywheel, as the generator field acts as such. A mechanical brake is also provided, but this is not used except when it is necessary to bring the car to a sudden or dead stop. If the controlling lever is thrown to the neutral position when the car is running at high speed a resistance is thrown in series with the motor, which develops a torque that tends to stop the car. This brake will not bring the car to a dead stop as its braking power depends on the car's motion, but it is very useful in keeping down the speed.

The storage batteries are charged from the motor, which contains an auxiliary field that furnishes current to the batteries when it is on high speed. These batteries are used for lighting purposes.

With these rapid advances in the electrical equipment of automobiles we may safely predict that the car of the near future will not only be started, lighted and its speed controlled by electricity, but it will be steered by this willing servant of man. It will require no more effort to drive a powerful racing car than it does to call a waiter. The control of these machines will be so simple that a five-year-old child can handle one with ease.

NEW ELECTRICAL MANICURE.

Los Angeles ladies are having their nails manicured by electricity. It's the latest method of beautifying the hands. Pink powders and polishers are unnecessary on milady's toilet table, for the same electricity which has been harnessed for great industries does its little turn in milady's boudoir and polishes dainty fingers.

Mrs. F. A. Scott, of Los Angeles, who conceived this latest device for manicuring and beautifying, declares it trims, files, cleans, smooths and polishes the nails in a most sanitary, businesslike way.

B-r-r-r! and one's nails are filed and cleaned by a little whirring machine. A faster revolution and the nails are polished with a shine that won't come off—a shade pinker than seashells. A third pressure of the button, a louder b-r-r-r and a splash of toilet water, and the work is done. Why don't someone invent a machine to give the male of the species a shave, a massage and a hot towel automatically, and finally to release the "hat" without the everlasting "tip!"

Do you enjoy this magazine? If so, tell others. If not, tell us. Remember we publish it to please our readers.

Marvels of Modern Physics

By Rogers D. Rusk
Assistant Instructor in Physics, Ohio Wesleyan University

SOME MISSING LINKS.

IT is just as important that the scientific man should know about the stumbling blocks of science, as that he should have a well ordered knowledge of the facts and laws already determined.

Man has perplexed his mind with many difficult questions. In the physical field alone he has asked himself: Is space infinite? What constitutes matter? How does gravity act? What is electricity? Etc., etc., ad lib., ad infinitum.

Ages of weary labor have been expended on these problems with the result that we are hardly nearer the direct answers than we were before. Some of the blanks seem likely never to be completely filled, but at least we know more extensively and accurately concerning them and the phenomena to which they are related.

Most of the puzzle questions of the scientists have not been practical and worth while, however. It has hardly been 500 years since scientists were loudly wrangling over such frivolous and absurd questions as, "How many angels can stand on the point of a needle?"

It was in the midst of these absurdities that Roger Bacon made his remarkable prophecy in the thirteenth century, in which he predicted the coming of the steamboat, railroad and aeroplane. His prophecy is the more remarkable coming from such an age, but unfortunately he added that the fountain of youth would be discovered and the baser metals changed into gold. Like perpetual motion they have always proved to be the phantom at the end of the rainbow.

To-day, excepting, of course, the absurd and impossible, there are still many missing links in our chain of knowledge.

Some years ago Physics was defined as "the science of matter, ether and motion." These terms at once suggest to our mind three of our big *Unknowns*.

The last two of these will be treated of in this article, while the subject of matter and its constitution will be taken up separately later.

With reference to motion, the different kinds are pretty well known and understood. Of course many perplexing questions can be asked such as: "How can the top of a cart wheel move faster than the bottom?" and, "Can Achilles ever overtake the tortoise?" but these are more mathematical than physical problems.

Two of the forces which cause motion, however, are much less well understood. They are gravitation and magnetism.

Isaac Newton is popularly accredited

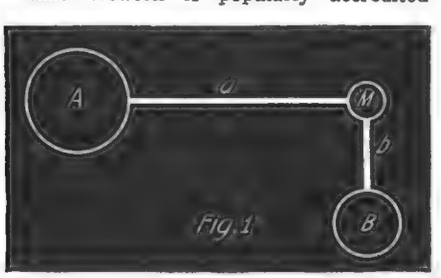


Fig. 1. Diagram Showing the Relative Pull of the Earth "B" and Sun "A" Upon the Moon "M."

with the discovery of the attraction which causes bodies to fall towards the center of the earth. Notwithstanding the familiar story of Newton and the falling apple, this force must have been recognized as a common fact long before his time. What Newton really did was to discover the universal law by which the force acted, and not the force itself.

This law—the universal law of gravitation—states that: "Every body in the universe attracts every other body, with a force that varies directly as the product of the masses and inversely as the squares of the distances."

This, of course, was a startling statement of the fact that the force we commonly term gravity is in reality a universal force acting between all bodies, and that it is only because the earth is so very large that it does not fall to the apple instead.

For a long time it was the pet dream of the more fantastic minded to discover a force of "negative-gravity" which would counteract or neutralize gravity itself, but the discovery of such a force seems quite far away indeed.

Newton's' law of gravitation brought out many interesting experiments. The sun,

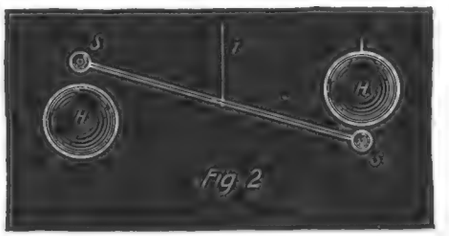


Fig. 2. The Famous Cavendish Experiment for Determining Relative Gravity Values.

moon and earth have each been weighed (a seeemingly difficult task) by an application of this law. If in the diagram, Fig. (1) "A" represents the sun, "M" the moon and "B" the earth, while "a" and "b" rep-

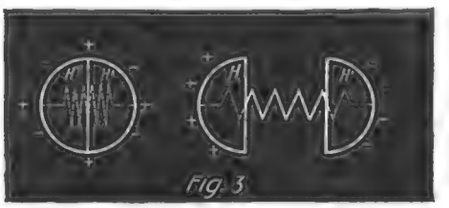


Fig. 3. Illustrating Mechanically a Sphere Containing Opposite Electric Charges.

resent their respective distances of 93,000,000 miles and 240,000 miles, then the ratio between the relative pulls of the earth and sun upon the moon works out to be about $\frac{120}{54}$. This makes the sun approximately 300,000 times the mass of the earth.

Now to find the absolute weight of any of the bodies, the weight of one must be found before the proportion can be formed.

This was done by Cavendish in 1798 in his experiment which has since become famous. He definitely measured the attraction between a lead sphere 12 inches in diameter, weighing 350 pounds, and a smaller sphere two inches in diameter, weighing one pound and ten ounces, and also the attraction of the earth for same. The previous problem was really repeated by Cavendish substituting two lead balls of known weight for the sun and moon. Thus the earth with its thirteen billion billion pounds was actually weighed. In Cavendish's apparatus, in order to double the effect, two large spheres were used, and likewise two small ones. These are represented in Fig. 2, and the small ones as shown were connected by a light bar and

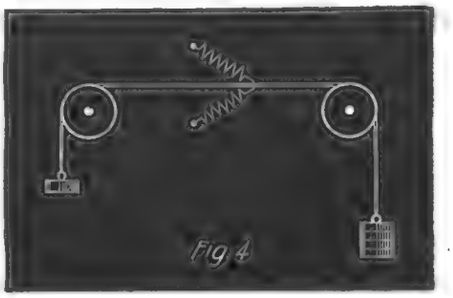


Fig. 4. Mechanical Analogy of Electric Strain Existing in a Charged Leyden Jar.

suspended by a thin silver wire. The amount of twist of the wire was then a measure of attraction between the spheres.

Many theories as to the nature of the force of gravitation have been presented, but the only theories which seem at all reasonable or possible imply the existence of some invisible and intangible medium which exists throughout all space, and permeates all matter; which exists between the heavenly bodies, beyond the limits even of any atmosphere.

In following this line of thought we are treading exactly in the footsteps of the older scientists, beginning with Newton.

Little of a definite nature was done with reference to the establishment of such a theory until 1678, when Huyghens, perceiving that light traverses a vacuum unimpeded, decided that it must have some medium to travel in or on. Also, as light comes from the sun, and even from the most distant stars, this medium must indeed be infinite in extent. Earlier theories of light had miserably failed, but Huyghens formulated his theory that light is nothing material, but that it is a wave motion in some invisible medium, which medium we call the *ether*.

Wonderful to relate, this theory, with the exception of a slight modification along electro-magnetic lines by Clerk Maxwell and others, is the accepted theory of today.

The development of our theory of the ether has been the biggest unifying factor in the history of modern physics. It has brought the different branches of physics in close touch, and paved the way for wonderful future progress.

There is little more to say concerning gravitation until we have considered the ether further.

Is the ether material or not? Matter is that which occupies space, but the ether does not occupy space in the ordinary sense of filling space. It is intangible and imponderable, therefore we say it is not matter; but on the other hand if matter is that which *exists*, and has certain physical characteristics, then ether may well be classed as matter. The horns of the dilemma are obvious.

Some years ago the ether was characterized as continuous (not composed of unit particles), infinite in extent, infinitely elastic, frictionless and without weight.

Sir William Thompson, however, made the interesting calculation, dependent on the displacement of a particle of ether in

(*Continued on page* 665.)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

The Cities of Mars

IF there is one thing that annoys me, it is a nosey reporter. To be sure, they are harmless folk, are reporters, and suave and well-mannered as a rule, too. But somehow their eyes always appear to me as gimlets and their noses as huge corkscrews, but then those are the characteristics of the tribe, and really they can't help it. It is their business to drill holes right through your mind, and once their corkscrew noses have dug themselves into your confidence they pull and pull till something comes up. A reporter can always dig news out of you, even if there's no news to be had. All of which might be of interest to you, and then again it might not. At any rate, the editor of the Yankton *Bugle*, who has heard about Münchhausen, sent a reporter to my laboratory in order to "write me up" and to find out if Baron Münchhausen was fiction or truth. Not that it was the first time that this particular reporter had called in vain. For I have a deep-seated aversion against the *Bugle*, which aversion includes everyone from the editor down to the job press. Hence I wasn't "in" to reporters heretofore. But on this occasion the reporter, who is a live one, succeeded in running the blockade. He "made up" as a water meter inspector, and as both the water meter, as well as my wireless station, are located in the basement of the house, he had but little trouble in "torpedoing" me. Once established in a chair there was nothing to do but to submit to his tortures.

Of course, he did not believe that there was such a thing as Münchhausen, who was supposed to live on Mars just now and who was supposed to send nightly wireless messages to earth, which are relayed to me from the moon by an alleged relaying plant located there.

However, the reporter was willing to obtain first hand evidence for his paper, and if I did not object very much he would stay till 11 p. m. in order to "listen in." To strengthen the argument he pulled out some two for 50c. Perfecto's (reduced to 40c. Saturdays only at Frank Levoy's cigar store on Main street). As my Nargileh wasn't working for lack of proper ammunition that evening, the argument proved convincing and I bade the reporter, whose name was Bill Snickles, to make himself at home. I explained to him all the good points and qualities of my wireless, and after the second Perfecto I was willing to let him photograph the station. He called up the office for the staff photographer, and after the flashlight had been taken it became time to adjust the instruments. In another three minutes Münchhausen would be calling. I had placed an extra set of 'phones on Snickles' head and I could see that he was breathing hard with suppressed excitement. I had keyed him up to such a pitch that when my chime began striking the first stroke of eleven he jumped clear out of his chair. But I smiled a very superior, benevolent smile at him, as a father smiles at his uncomprehending babe. I then leaned back comfortably, toyed a bit with the Harmonic Ultra-Amplifier, adjusted the Selenium Vapor Enforcer, and turned once more the knobs of the coupled inductance balancer to make sure that I was tuned in for 90,000 meters—the wave length used by Baron Münchhausen.

The chime had sounded its last stroke. In another second the dear old gentleman's voice would greet me as usual.

Have you ever wished to "show off" to your friends or to your relatives and the "show off" failed to materialize? Have you ever experienced the cunning feeling of an icy cold wave racing up and down your spine, to be followed immediately by a hot blast up and down the self same spine? And has the perspiration broken out all over you at the contemplation that the "show off" was a fizzle? Yes? If you have, you know exactly how it feels.

At 11.05 p. m. I began to wonder why, it was so hot in the room. By 11.10 p. m. I was taking a Turkish bath. By 11.20 p. m. I calculated that my private temperature must have gone up to somewhere near 269° Fahrenheit, rising steadily all the while. By 11.30 p. m. I wasn't sure whether I preferred calling an ambulance or jumping into the ice covered pond in front of the house.

Münchhausen simply didn't "call." What was wrong? Why had he failed me for the very first time, just when I could least afford it? For the first time since I knew him I felt bitter toward him. What had happened?

And there was Snickles with a sarcastic grin spread all over his bird-like face, making biting remarks all of the time.

"Maybe the ether gave out, what?" he mocked. Or: "Maybe Münchhausen has a Martian frog in his throat and can't talk!" Or else: "Isn't it possible that the message became lost in transit? In that case I would suggest that you put an ad in the *Bugle's* Lost and Found co....."

That was the last straw. He didn't finish the sentence and he didn't wait to take his hat either. He went out like a blue streak, with me at his heels. But reporters, among other accomplishments, must be good runners. He is. At any rate, I did not catch him. Disgusted and in a white rage, I went to bed.

My ruffled feelings were not particularly smoothed next morning when my young brother brought me a copy of the *Bugle* while I was still in bed.

Snickles had certainly outdone himself. The whole town would choke with merriment when they would read the account, there was no doubt about that. The headlines were enough:

I. M. ALIER MAKES STUPEFYING INVENTION.

RECEIVES SOUNDLESS, VOICELESS, MESSAGES FROM MARS.

ALLEGED HERO, MÜNCHHAUSEN, SPEECHLESS WITH SURPRISE.

MÜNCHHAUSEN SAYS HE AIN'T SAYIN' NOTHIN'!!

And so on, and so forth. The article was written so excruciatingly funny that I had to laugh myself, despite my rage. But the laugh froze to ice when my eyes had passed over the line where Snickles had written ironically:

"Undoubtedly Münchhausen was asleep at the switch!"

With one bound I was out of bed and was racing madly down to my wireless station barefooted. I gave one look at the lightning switch in the corner of the room and almost collapsed:

The switch was grounded and had been grounded since noon of the previous day!

For you may know that the Fire Underwriters nowadays require wireless stations to have lightning switches in order to protect the building from lightning. Thus when your station is not in use you simply connect the aerial to the ground by throwing the switch, and no damage can be done by a thunderbolt. Not only that, but in this condition the aerial becomes really a first class lightning arrester.

Sad to relate, however, certain idiots are apt to forget to throw the switch over when trying to receive messages, I being among them that evening. For when the reporter called so unexpectedly I forgot all about the switch and never bothered to look around to see in what position it was.

Münchhausen had called, of course, of this I was certain. The message, however, had flown from the aerial directly to the ground, never entering my receiving instruments Lost and lost forever! And my thoughtlessness had made me the laughing stock of the town on top of it! It was maddening. Right then and there for the next ten minutes I had what my little sister very appropriately terms as a series of rather violent "conniption fits!"

* * * * * *

That evening promptly, as always, Münchhausen "called." He did not waste much time in preliminaries, but went right to the point:

"Alier, my dear boy, I can't begin to tell you how wonderful this planet Mars is with all its marvelous inhabitants. Flitternix and myself are as in a trance half of the time. Our brains simply cannot digest all the thousands of wonders we see around us every minute. For a poor untrained human mind to be suddenly transplanted into a civilization hundreds of thousands of years ahead of terrestrial civilization is no easy matter. At times we are positively numb with astonishment and the more we see and learn the less we feel we know. Every new marvel opens up a dozen new unfathomable avenues, each one equally puzzling.

"But to proceed. Yesterday I explained

MANY of our astronomers have noted from time to time that immense sandstorms frequently sweep over the face of the Planet Mars. As such storms seem to cover vast areas it would appear that the sand must of necessity be rather light to float in the thin Martian atmosphere. For this reason, it is reasonable to suppose that the sand is extremely fine—dust in other words. But how can intelligent beings live permanently in an atmosphere loaded with fine dust? This instalment advances a new idea how the Martians may make life bearable on their desert planet.

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to you how we had our first Martian meal at our host's residence and how we experienced that gaseous food that you don't need to chew, is vastly more nourishing and satisfying than solid food. It does not overload the stomach as do solids and the digestion is vastly improved. The gases liquify, of course, in the stomach, but the latter itself never becomes distended. Besides, the Martians, trained rigidly from earliest childhood, know just how much gaseous food they can assimilate. This, I understand, is one of the reasons why the average Martians live over 150 Martian years, which is 300 terrestrial years.

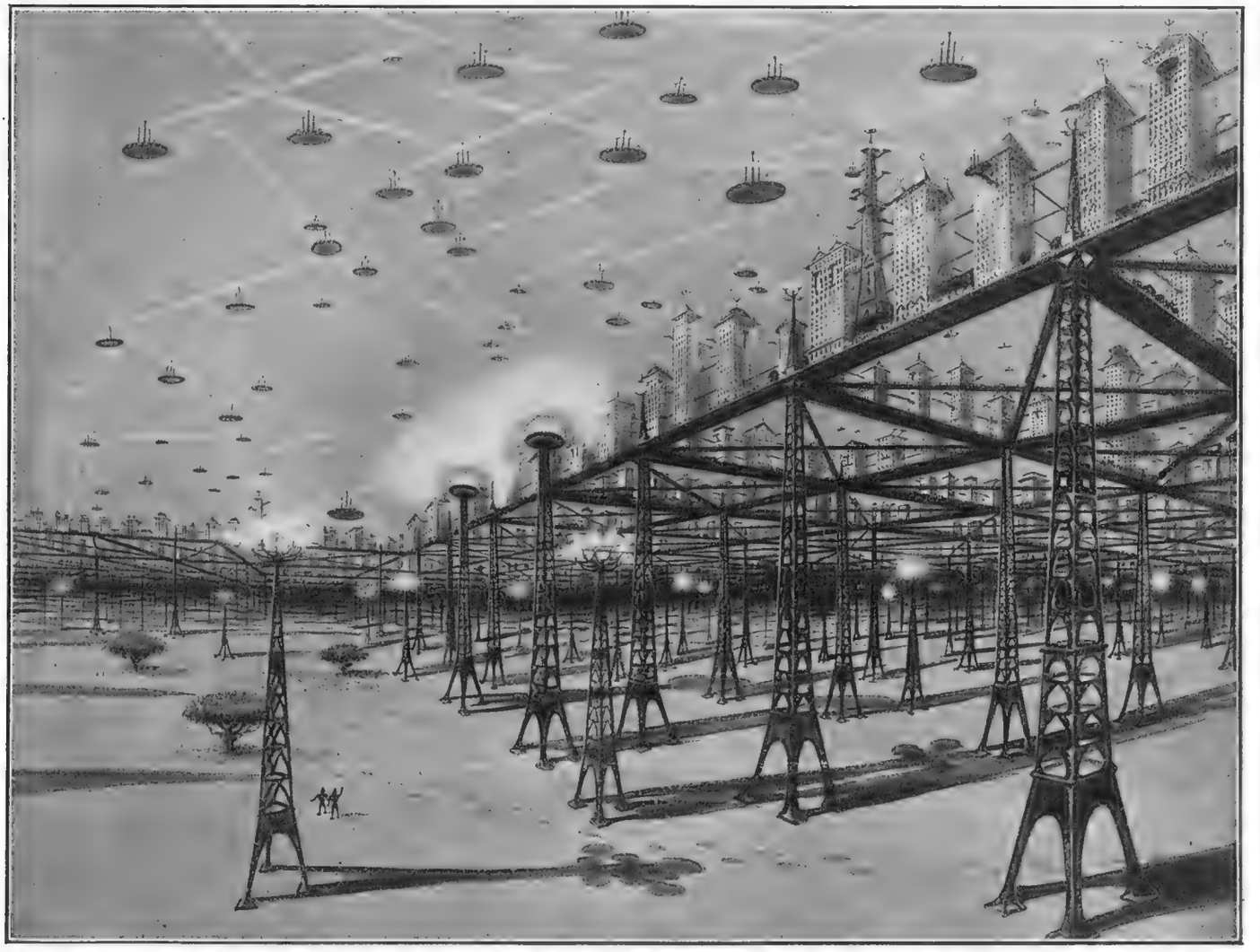
"After dinner we were conducted to the roof of our host's mansion, where we made ourselves comfortable in the large transparent chairs scattered around beneath a cool, green, silky-appearing canopy. As I mentioned to you previously, the Planet Ruler's mansion resembles somewhat a colossal cathedral. The roof is about 250 feet from the ground and the entire structure rotates slowly around on its axis. This is the reason: While the Martians are enlightened enough to have no religion whatsoever, they know what we have known for some time, namely, that life on all planets is absolutely dependent upon the sun. Extinguish the sun to-day and all the planets throughout our planetary system from Mercury down to Neptune will become dead worlds. Without sunlight the rivers will cease flowing within three weeks. Within six months all waters on earth and Mars will have frozen down to the bottom. The vegetable kingdom will have ceased long before that and the animal kingdom, dependent upon the vegetable kingdom, will die even a more rapid death. In less than two years the last surviving human on any of our planets will have ceased living. There can be no organized life as we know it without the direct influence of a live sun.

"While the Martians are by no means sun worshippers, they nevertheless have a deep-rooted feeling for our luminary. This is strikingly illustrated by the fact that the Planet Ruler's mansion is constructed in such a manner that powerful machinery revolves the entire structure silently during the entire Martian day; the first rays of the morning sun thus shine into the Ruler's private rooms, and as the sun keeps on rising the house keeps pace and thus the entire day till the last sun ray creeps over the western horizon, the Ruler's windows are bathed in sunlight. During the night the house does not revolve.

"The day we were on top of the Ruler's mansion was still our first day on Mars. It was then in the early afternoon, after lunch time, as mentioned before.

"Down below we looked upon the 'city,' which seemed to be laid out in form of a vast semi-circle, as far as we could ascertain. To the west we could just glimpse one of the water ways.

"We stepped to the balustrade and peered down, completely stupefied with what we saw. But Flitternix, his mind full of astronomical observations, called my attention to the heavens and I followed his command reluctantly.



"It was found that the ordinary desert dust did not usually rise higher than 400 feet above the surface of the planet. For this reason all buildings and structures on Mars, with few exceptions, are located 500 feet above the ground. . . ."

"'You will observe,' said he, pointing at the sun, 'that it appears quite a bit smaller than when seen from the earth. It also does not appear yellow-white, as it looks to terrestrial inhabitants. You will note it has a rather reddish hue; that is because we are now a good bit further away from it, a matter of over 60,000,000 miles further than on earth. In other words, we are now twice as far away from the sun as we are on earth. But you must have observed how warm it is everywhere on Mars, as far as we have visited it, and that the day appears fully as bright, if not brighter, than on earth. Naturally you will wonder, for on Mars, as well as anywhere else in the world, certain physical laws hold good. Thus heat and light diminish inversely as the square of their distance, in other words, a 16 candlepower lamp two feet away gives only one-quarter the light (four candlepower) of the same lamp if seen at one foot away. Heat acts in exactly the same manner. Then why is it that the day is as bright, and the heat as great as on earth, although we are twice as far removed? According to the physical law just mentioned Mars should only receive four-ninths of the light and heat from the sun as does the earth. Why does it receive more? Early astronomers on earth rea-

(*Continued on page* 658.)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

How to Organize and Conduct a Radio Club

WITH the advent of The Radio League of America, the details of which organization were given in full in the December, 1915, issue of *The Electrical Experimenter*, there has been opened up a wider and more promising field than ever before for the formation of subsidiary or local radio clubs throughout the country. Given the proper spark of enthusiasm, there is no city or hamlet too small in the whole United States but what it could support one or more such radio clubs.

Possibly you, as a radio enthusiast, even though you may not have a very elaborate wireless station (either for receiving or transmitting, it matters not), have often thought it would be a fine idea if you could band together several other similarly interested persons either from an experimental, scientific or amateur standpoint.

Preliminaries.

To start a radio club or society there are several methods which may be employed to aid the formation of such. One of the first things that can be done is to write a letter to the manager of the Radio League of America stating briefly your intentions and desires, at the same time asking for the names and addresses of any other radio amateurs in your particular locality. Upon receipt of this information you can then either visit the experimenters personally or a very good scheme is to write each a letter, explaining your ideas and suggesting a date for a meeting at which the matters pertaining to the formation of a local radio club can be talked over.

In some cases such organizations are formed and many details of the work are finished *via wireless*, as, for instance, when the "organizer" has a radio transmitting and receiving station so that he may call up other amateurs by noting their call numbers in the regular Wireless Call books. Still another scheme which can be followed out in many such cases, and also at an insignificant cost, is to insert an advertisement in your local newspaper, stating that the advertiser would like very much to have all those interested in experimental wireless telegraphy call at his residence on an appointed evening for the purposes set forth.

One of the first things that has to be considered after a response has been had to such an advertisement or other campaign as aforementioned, is the rules of order to be followed in forming the organization. It may be said that many small clubs do not go in for the deeper legal rules usually governing such bodies. The appointment of an inspector or engineer as one of the officers, together with the president, vice-president, secretary and treasurer (the two latter officers are very often combined) suffice for all practical requirements.

It is a very good idea to select a capable member to act as consulting engineer, and whose duties shall cover the visits to each member's station for the purpose of checking up his wave length, deficiencies in operation of the apparatus, etc.

Maintaining Interest in the Club.

Once the radio club has been formed, it is not always an easy matter to maintain the interest in same by the members. A good leader in any event will help to overcome this trouble to a large extent, but of course he must be aided in every way by the other officers of the club. One of the first important things to be done when starting a new organization is to select for the first few meetings, at least, some particularly good wireless or allied papers. They advisedly should not be of too technical a nature, as it may discourage some of the younger members or others who are not so far advanced in the science. A good suggestion in this direction is, whenever possible, *try to obtain the services of an instructor in radio operating and engineering from a local school or college,* who in most instances will be only too glad to make a short address at any time, before such an organization.

The Very Fine Radio Equipment of the Minnesota Wireless Association, Minneapolis, Minn. Insert Photo Is That of Miss Aline Mengelkoch, a Radio Enthusiast, Who Often Operates the Set Here Shown.

A letter of the proper sort, addressed to such men, will invariably result in their acceptance of your proposition. It will be readily seen that a greater impetus will be given the club if such speakers are engaged at least for the first few meetings. A case in point is the Radio Club of America, with headquarters at New York City. This organization has been coming to the front very rapidly in the past two years. Many of the speakers at the monthly meetings are some of the leading instructors and engineers in the wireless profession; men who also address meetings of the Institute of Radio Engineers, which body is, of course, the foremost scientific radio organization in the world, counting among its members the leading wireless engineers and scientists of all countries. The office of the secretary of the Institute is at 233 Broadway, New York City. The monthly meetings are held on the first Monday of each month in Fayerweather Hall, Columbia University, New York City, at 8 p. m. This Institute publishes its proceedings, containing the more important articles presented at the various monthly meetings, four times a year; that is to say, the proceedings come out quarterly and form a most valuable addition to any radio operator's or engineer's library. The dues for an associate membership are $4 a year, and so far the Institute has managed to publish its proceedings and defray its other incidental expenses with but little extra financial aid from a few of the members.

It is not intended to dwell upon the features of such an extensive body as that now under discussion, but it may be said that while the interest among the members has flagged at different times, notably several years ago owing to the great shake-up in the business affairs of several commercial wireless companies, etc., it should be said that those managing the affairs of this organization have always kept in mind the point previously mentioned, i. e., that it is best to obtain the services of the very best speakers and lecturers in this line whenever possible.

The small radio clubs just forming, however, need not feel discouraged if they cannot obtain a speaker of prominence or great learning to address them, as in many instances there are one or more energetic and capable radio men among their own members who will probably in many cases

prove better as leaders for such bodies of youthful experimenters than a more mature individual of more advanced and professional inclinations.

Club Dues.

Speaking of club dues, this is an important point. As many of these societies meet at the members' houses, there is then no rent to be considered. The smaller clubs, of course, can run along quite nicely with but a small budget or expense, except that necessary for buying stationery, having cards or literature printed, etc. For the younger clubs, composed of members between the ages of 12 and 15, the dues should not reach much above 25 cents a month. But with clubs made up of older members than those just mentioned and having club quarters for which rent must be paid there will, of course, have to be a higher monthly due levied. Most of the larger organizations have an entrance or initiation fee of perhaps $1, but this, of course, will have to be considered and worked out by the officers in charge of the affairs of the club. This factor will vary in the different localities and with the different classes of members.

Investing in the Club.

While it is not desirable in any event to work hardships upon the members of the radio clubs, it should be borne in mind by the officers of such that the organizations enjoying the greatest popularity are those in which the members are very vitally and personally interested. This comes to the point of having each member invest in the club, which may be brought about by bringing the propositions before the organization at one of the regular meetings. A great many of the societies to-day have excellent wireless sets maintained at the club quarters and, of course, in this instance the rooms are invariably open every day, or at least every evening, so that those members who so desire may come to the rooms for practice or training in the handling of the radio apparatus. There should be a chief operator appointed, and also when occasion demands it, someone who shall be responsible for the proper maintenance of the wireless set.

It is best to choose a fairly good wireless transmitting and receiving set, which can, of course, be had at all prices imaginable, say from $10 up, and even for a lesser amount when the club is a small one.

Excellent Wireless Exhibit of the Atlanta Radio Club, of Atlanta, Ga., an Example of What a "Live" Organization Can Accomplish.

In this direction we would like to call the reader's attention to the excellent photographs reproduced here and in other forthcoming issues of *The Electrical Experimenter* showing what can be accomplished by a good, "live" amateur wireless organization.

In the first illustration we wish to mention the excellent wireless set owned by the Minnesota Wireless Association, of Minneapolis, Minn. Particularly in this connection we wish to call attention to the excellent work accomplished on this outfit by Miss Aline Mengelkoch, whose picture is observed in the upper right corner of the illustration of the station. Miss Mengelkoch is very enthusiastic about wireless telegraphy and is said to be the youngest commercial woman operator in the United States, she having just received a first-class Government radio operator's license. She can transmit and receive messages at the rate of 35 words per minute and, moreover, is widely read on the subject of radio telegraphy.

This is a good matter to keep in mind in club affairs. Do not forget your sister or girl friend who may have scientific inclinations. Get her to join the club, as there is a wide field open, indeed, for wireless experts, and the excellent work of Miss Mengelkoch before cited, as well as that of several other women operators, proves that she can engage in this field as successfully as in any other.

While on the subject of amateur wireless clubs that are doing big things, we would call attention to our illustration which represents the excellent wireless exhibit conducted by the Atlanta Radio Club, of Atlanta, Ga. The address of the vice-president of this club, R. A. DeVore, is 19 Second avenue, Oakhurst, Atlanta, Ga. It is really wonderful to contemplate the achievements of this organization, which was started but little over a year ago. It has received many congratulations on the exhibit which it arranged and which formed a part of the recent Electrical Show held in Atlanta.

The exhibit attracted great attention. One of the most interesting features, perhaps, was an exact replica of the first Marconi wireless set, complete with induction coil and coherer. Near this was a complete sending and receiving set of modern type, owned by member of the club, with which bona fide radio messages were received and transmitted. The visitors to the show were given popular lectures by members of the society on the theory and practice of wireless telegraphy, and, together with practical demonstrations, they were made to appreciate the rapid strides made in radio work the past few years.

The Electrical Show was held on the ground floor of a large office building, upon the roof of which was erected an aerial, the height of which was nearly 200 feet and the total length 400 feet.

Another point of interest was a table 5 by 15 feet, completely covered with send-

(*Continued on page* 664.)

REVISED LIST OF AMATEUR RADIO CLUBS

Akron Radio Club, 760 Damon place, Akron, O. Secretary, A. A. Crum, Radio department, G. T. & R. Co., Akron, O.

Amateur-Scientists, Public School 66, room 256. Secretary, Harry Fienberg, 124 Amboy street, Brooklyn, N. Y.

Amateur Marconi Radio Association, 614 Fifth avenue, Troy, N. Y. Secretary, D. Malcolm Williams, 1627 Seventh avenue, Troy, N. Y.

Bradentown Radio Club, Stockbridge avenue, Bradentown, Fla. Secretary, Hughson Hurlebaus, 439 Main street, Bradentown, Fla.

Carrollton Radio Intercommunication Club, Fifth Street Public School. Secretary, Stuart W. Pierson, 214 Maple avenue, Carrollton, Ill.

Chicago Wireless Association, room 1010 Lake View building, 116 South Michigan avenue, Chicago. Secretary, Frederick D. Northland, 24 Scott street, Chicago, Ill.

Colorado Wireless Association, 600 Y. M. C. A. building, Denver, Col. Secretary, L. P. Hough, 600 Y. M. C. A. building, Denver, Colo.

Cranford Radio Club, Cranford, N. J. Secretary, Russell Damon, Arlington road and Madison avenue, Cranford, N. J

East Night High School Radio Society, Woodward High School. Secretary, C. H. Fender, Woodward High School, Cincinnati, O.

Fall River Radio Association, Technical High School, Fall River, Mass. Secretary, Lawrence Phelan, 6 Rodman street, Fall River, Mass.

Hawkeye Radio Association. Secretary, A. B. Church, Lamoni, Ia.

Inter-City Radio Association of Allentown, Pa., Y. M. C. A. building. Secretary, William J. Kreis.

Junior Radio Club, Gregory street, Pensacola, Fla. Secretary, Oliver Williams, Pensacola, Fla.

Philadelphia Radio Association, 4810 Germantown avenue, Philadelphia, Pa. Secretary, G. S. Ballantine, 4810 Germantown avenue, Philadelphia, Pa.

Radio Club of the Polytechnic Institute of Brooklyn, 85 Livingston street, Brooklyn, N. Y. Secretary, R. G. Wehle, 85 Livingston street, Brooklyn, N. Y.

Radio Club of Union College, Union College, Schenectady, N. Y. Secretary, Edwin A. Schahbehar, 242 Union street, Schenectady, N. Y.

Rockaway Radio Club, 296 Washington avenue, Rockaway Beach, N. Y. Secretary, L. Wagerer.

The Talo Club, New York City. Secretary, Edward T. Dickey, 1649 Amsterdam avenue, New York City.

Technical Wireless Association, Washington, D. C. Secretary, Edwin D. Powell, 908 Kennedy street, N. W., Washington, D. C.

Wireless Association of Central Pennsylvania, Harrisburg, Pa. Secretary, D. H. Zorger, 409 Kelker street, Harrisburg, Pa.

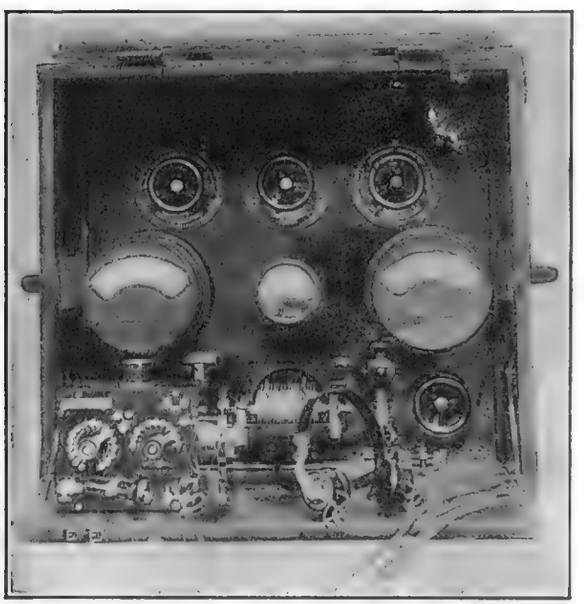
Yorkville Radio Development Association, 73 East End avenue, New York City. Secretary, Joseph L. Cermak, 73 East End avenue, New York City.

Notice: To ensure proper entry of club registrations in our revised monthly list be sure to send us at once the data outlined below. Such information should reach us not later than the 28th of the month for entry in the succeeding issue of THE ELECTRICAL EXPERIMENTER.

Name of Club .....
Location (street and city).....
Founded .....
No. of Members.....
Meeting Date .....
Power of Club Set, if any.....
Call Letter (licensed?).....
Dues and Initiation Fee.....
Secretary's Name and Address.....

New 500 Watt Military Radio Pack Set

THE wireless sets used for military purposes, and particularly those now in use by the United States army, consist of the very best instruments that can be purchased. These sets must work under every possible condition. The accompanying illustration shows one of these extra sturdy pack outfits, which at the same time combines extra high efficiency in both the transmitting and receiving ranges attained, as well as in small space occupied.



Extremely Compact 500 Watt Military Radio Set.

These sets are of the portable style, equipped with generators of the 500-cycle alternating current type fitted in a separate case, so that it is thoroughly portable and may be carried on separate trucks. The cases are unique in construction, consisting of a substantial wooden frame or base, so to speak, which is covered both on the inside and outside with a 1-16 inch layer of gray sheet fiber. This is glued to the wood under hydraulic pressure. The cabinets are protected by hard fiber angle strips riveted on and further protected from damage by iron bumpers at the corners.

The apparatus, such as volt-meters, ammeters and hot wire meter, as well as transmitting inductance control handles, etc., are all mounted on the micarta panel. The quenched spark gap of special design, perceived at the base of the panel, is cooled by a small electric fan placed behind it, so as to blow a draft of air directly over the gap. The gap plates rest in micarta guides. Their sparking surface, which is at the center, is of pure silver. This surface measures 3-64 of an inch in thickness, with a diameter somewhat larger than that of the metal plates supporting them and on which they are soldered. The silver is then spun over and riveted down.

The condenser bank for this 500-cycle transmitting set is composed of six condenser units of practically .002 micro-farad each. The resulting capacity of the whole bank, after the condensers are connected in series-parallel, is .013 micro-farad.

The step-up transformer, of the resonance type, is of the open-core pattern and is mounted within the case, back of the micarta panel containing the measuring instruments, etc. Silk-enameled magnet wire is used in winding the secondary of same, which is of the dry form, not requiring any oil for its insulation. Various transmitting wave lengths may be quickly arranged for by means of calibrated inductance control handles and scales mounted on the front of the upright panel of the set. A regular Morse key is perceived at the right of the cabinet

The receiving set is very compact and may be observed resting on the drop front of the transmitter cabinet, at the left of the illustration. The head 'phones are the well-known adjustable-magnet type supplied to the United States army and navy, and in which the distance between the pole-pieces and the diaphragm may be varied as required for different strengths of signals by means of an adjusting screw at the back of the receiver case. The receiving set is a beautiful piece of apparatus, which includes a Pyron detector. The primary coil of the loose coupler is wound with 170 turns of No. 22 enameled copper wire, divided up into two sections, one of 10 turns and one of 150 turns. These are suitably connected up to switches, so that any combination of turns, from one to maximum, may be obtained rapidly.

The whole receiving set is installed in an oak cabinet with hard rubber top and end, upon which the switch points are mounted. It also contains a series condenser for short wave lengths, but which unit is normally short-circuited by a special switch. The secondary is also adjustable as to the inductance, and as it slides out of the primary cabinet its graduated tubular covering indicates the percentage of coupling. Photo courtesy Wireless Specialty Apparatus Co.

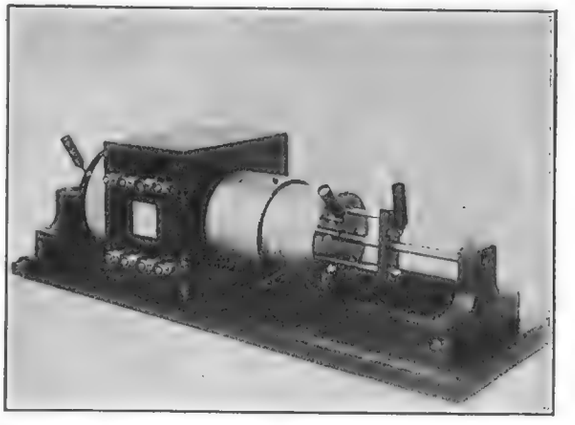
A NOVEL RADIO INDUCTIVE TUNER.

Since the introduction of the loose coupler there have been few, if any, radical changes in the design of same. The change from sliders to tapped coils was so slight as to make very little improvement, so it remained for a radio engineer of a later day to devise the apparatus shown herewith.

The old type of inductive coupler was adjusted in steps, which did not give very close tuning, and the presence of large amounts of unused wire created the bugaboo of all previous tuning apparatus, namely, "dead-end" effects, which absorb considerable energy and destroy the efficiency of the apparatus. To offset the above defects it was the general practise to use variable condensers to secure accurate tuning, and many complicated switches were devised to prevent the dead-ends. The coupler illustrated herewith does not require any taps or variable condensers, all the wire on same being in use at all times. A brief resume of the principle of this instrument will not be out of place.

The primary consists of two coils, one permanently fixed in the box, shown in the illustration, and the movable one shown at the left. These two coils are wound to have an equal amount of inductance, but in opposite directions, so that when the movable coil is slid entirely into the fixed coil the sum of their inductances will be zero, because they oppose and counteract each other.

The same principle is used in the construction of the secondary, which consists of two coils shown protruding from the end of the box to the right. These coils also have the same amount of inductance, and they also counterbalance each other when the inner coil is entirely within the outer coil. It will be apparent that when withdrawing the inner coil the exact balance of the two inductances is upset and the circuit will possess an inductance depending upon the relation of the two coils. By this simple means it is possible to adjust the active inductance in either circuit, thus doing away with all taps or sliders.



New Loose Coupler, Adjusted Without Sliders or Switches.

The secondary coils may be moved inside of the primary coils, so that by varying the inductance relation between the two sets it is possible to vary the coupling.

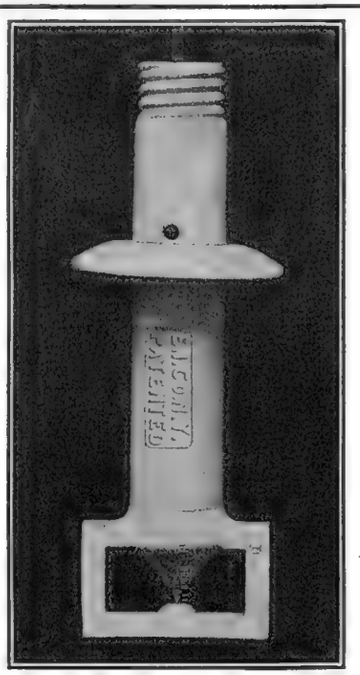
The many advantages of this apparatus will now be readily understood, for it gives

(*Continued on page* 667.)

NEW ELECTROLYTIC INTERRUPTER ELECTRODE.

An improved form of positive electrode or anode for electrolytic interrupters has been perfected by a well-known New York experimental supply house. The tube is shown in the illustration herewith. It consists primarily of a specially designed porcelain tube, which carries a thread at its upper end, intended to screw into a porcelain cover. A metal rod made of a special alloy passes down through the interior of the tube, and the point of same protrudes through a small orifice slightly larger than the rod at the base of the tube proper, as perceived. The metal wire point rests on a porcelain bridge, as illustration portrays, so that excessive current will not be drawn. Any electrolyte which may find its way into the interior of the tube by working in around the metal rod will be ejected through three small perforations in the wall of the tube just above the porcelain skirt formed on the tube about two-thirds of the way up, as perceived.

It is claimed that this marks a great advance in the design of such devices and actual laboratory tests have demonstrated that for operating wireless coils, X-ray coils and open core transformers up to one kilowatt capacity there is nothing superior to it. It will work on either A. C. or D. C. circuits at 110 or 220 volts potential and on any frequency. *The key may be held down for periods of one-half hour or more* and the interrupter will work regularly and without undue overheating. An interesting point is found in the fact that the lower end of the rod during operation wears away to a *perfect* sharp point. The rod which is consumed slowly in operation is fed down automatically by gravity. It offers a practical solution of the power transforming problem constantly confronting the wireless and electrical experimenter, especially where he desires to utilize the commercial power circuits to operate his spark coils and the like, and where he desires to utilize direct current on an open core transformer. Such interrupters are not adapted for operation with closed core transformers.



Improved Electrolytic Interrupter Electrode Recently Brought Out. The Metal Rod Cannot Drop Through the Tube, Owing to a Porcelain "Bridge" Formed as Shown.

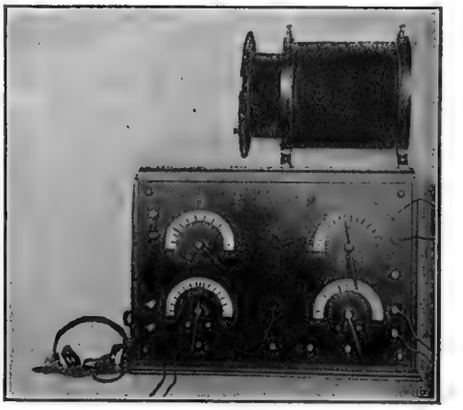
AN UNDAMPED WAVER.

A great deal of speculation has been made during the past two years by the majority of amateurs in regard to the reception of undamped waves emitted by the powerful radio stations about the globe; practically all the long distance transmission records have been accomplished only by the use of undamped waves.

The ordinary radio receiver is deaf, so to speak, to the undamped waves, so other apparatus had to be developed to receive them. Although various detector devices have been invented for this purpose, none have proved superior to the oscillating audion detector. This produces "beats" which are created by the use of properly designed inductances and condensers linked up to the audion circuit.

One of the latest receivers for undamped waves which employs the audion as a generator of "beats" is herewith illustrated. A large loose coupler is seen resting on top of the cabinet. The case contains four variable condensers which are provided with long insulating handles, the pointers of which move across the dials on the face of the instrument, as perceived in the illustration. The purpose of these handles is to prevent capacity effects due to the operator's body. The cabinet also contains the necessary inductances, the values of which can be changed by means of the jack and plug system; the jacks being located on the front of the board, as can be clearly seen in the illustration.

With the loose coupler herewith shown in connection with the variable condensers, wave lengths up to 15,000 meters can be readily obtained.



New Loose Coupler and Variable Condenser Cabinet Known as an "Undamped Waver," and Intended Especially for Receiving Continuous Wave Signals.

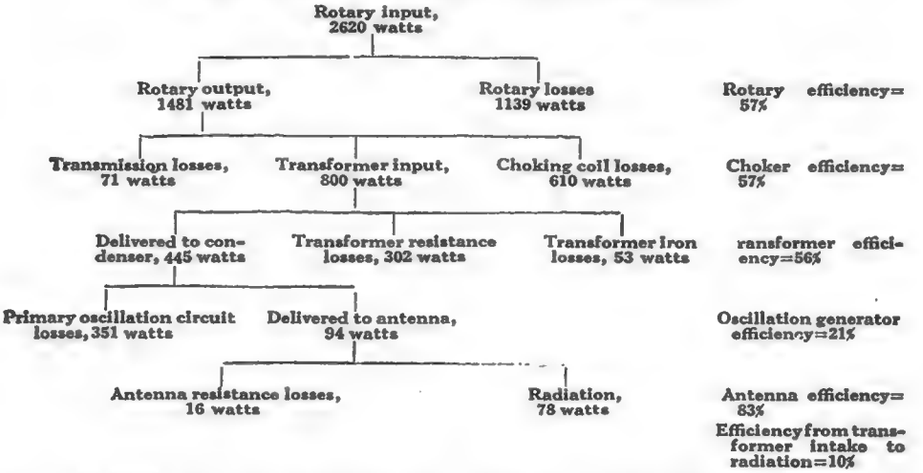
OVER-ALL EFFICIENCY IN RADIO TRANSMITTING STATIONS.

Several very vital figures are given in Dr. J. A. Fleming's new treatise, entitled "The Wireless Telegraphist's Pocket Book." We reproduce herewith an interesting chart as there given, covering the various losses in the apparatus constituting a typical transmitting set of the spark gap type. It is pointed out in the treatment of this subject to Dr. Fleming that, while these values as here reiterated are of considerable value as an over-all consideration, in respect to the over-all efficiency of modern transmitting sets, utilizing quenched spark gaps, etc., it may be a great deal higher. In comparing the power radiated, viz., 78 watts, with the power given to the step-up transformer, i. e., 800 watts, it is seen that for this particular transmitter the over-all efficiency is but 10 per cent., approximately. In the case of a well-designed spark transmitter the over-all efficiency might be raised to from 20 to 25 per cent.; that is to say, that almost one-quarter of the power given to the step-up or exciting transformer would be radiated as electric waves. Claims have been made for much higher efficiency in such apparatus, particularly for quenched spark sets when this value has been mentioned as reaching 75 per cent., but these claims have not been substantiated. This acknowledged authority points out that it is probably correct to say that the properly designed quenched spark transmitter's efficiency *may* reach a figure of 50 per cent.

He believes that it will not be far wrong to consider that in a fairly good, modern type spark transmitter, with quenched spark gap or gap equipped with an air blast, the power radiated from the antenna can be as much as 20 or 25 per cent. of that given to the exciting transformer, but it is not usual to find such high values as these. In order to realize such radio transmitter efficiency, however, great attention must be paid to the construction details of the condensers and also to those of the primary oscillation circuit and of the spark gap, as well as to the earth connection proper and to the construction of the antenna, in order to avoid undue resistance losses in these most vital parts of such a station.

EFFICIENCY CHART FOR U. C. L. RADIOTELEGRAPHIC EXPERIMENTAL PLANT, WITH 5 mm. SPARK GAP

(From tests by Dr. J. A. Fleming, at University College, London.)


Rotary input, 2620 watts
Rotary output, 1481 watts
Rotary losses 1139 watts
Rotary efficiency= 57%
Transmission losses, 71 watts
Transformer input, 800 watts
Choking coil losses, 610 watts
Choker efficiency= 57%
Delivered to condenser, 445 watts
Transformer resistance losses, 302 watts
Transformer iron losses, 53 watts
ransformer efficiency=56%
Primary oscillation circuit losses, 351 watts
Delivered to antenna, 94 watts
Oscillation generator efficiency=21%
Antenna resistance losses, 16 watts
Radiation, 78 watts
Antenna efficiency= 83%
Efficiency from transformer intake to radiation=10%

The Evolution of Wireless Telegraphy

THE evolution of signaling without wires has been an interesting one. Since the earliest dawn of reason man has found it absolutely necessary to transmit important intelligence through space. Particularly in case of war between the various tribes quick intercommunication was desirable. As the fleetest runner, as well as the speediest rider, were soon found wanting, methods were naturally sought to outdistance both. In the illustrations here observed we have endeavored to show the principal modes of signaling without wires utilized in the various stages of the world's history.

Perhaps one of the first mentions is made in the Bible, when the Israelites were led out of Egypt and through the wilderness by a cloud of smoke by day and a pillar of fire by night. Possibly one of the first methods of signaling across an appreciable distance of a few miles was that involving the use of fires kindled on the hilltops or other promontories as depicted in Fig. 1. In this way it was quite possible to communicate intelligence accurately, although not very rapidly, to be sure. This scheme was first used in very ancient times.

The method of signaling shown at Fig. 2 is that employed at quite an early date, but notably by the North American Indians. This consisted in building a fire on a hill or mountain whenever possible, so that a column of smoke or a series of smoke puffs, could be sent up, and in this way communication was established between tribes. It was this method that was often utilized by the Indians when making war on the white settlers in America. The fire was made to smoulder by the use of wet sticks or leaves. The Indians were quite proficient in making fires producing a prodigious amount of smoke, which could be seen for various distances, depending, of course, upon the height of the hill upon which the fire was built, but a range of ten to fifteen miles was undoubtedly common in those days with this method of wireless communication.

Fig. 3 illustrates a little known yet very effective method of transmitting intelligence, which is attributed to certain tribes of Indians in South America; it has been described by returning explorers at different times. It may be expressed briefly as "drum beating," but the drum is no ordinary one. It consists of a hollow log, or a log made so by burning out the interior. Over the end of same is stretched the hide of an animal, which is pulled very tightly and bound by thongs. The log is then suspended, as perceived in the illustration, so as to exert the maximum resonating effect as the signaler beats the head of of the drum with a stick provided with a wooden head, or in some cases with a stick having at its extremity a ball formed from a piece of hide and loaded with a round stone. We have been credibly informed that this method is in successful use at present, messages being actually transmitted (using relay stations) over a distance of 300 miles almost every day.

Wigwagging is still in use to a great extent throughout the world, especially in the army and navy, where it has proved invaluable in many instances. This mode of signaling, which usually consists of wagging a flag or semaphore arm in different positions, representing the various letters of the alphabet, was employed at quite an early date. The illustration at Fig. 4 shows the semaphore arm as made use of for sending such signals over great distances. In the wonderful campaign of Napoleon carried out through France, Germany and Russia numerous messages were transmitted without wires in this way. In one case, it is said, that such a message was transmitted in a few hours' time from Moscow to Paris. Of course, this distance was not negotiated by one semaphore only, but the message was relayed from signal station to signal station, much in the same way as wireless messages are relayed now from ship to ship or from one ship to another and thence to shore, etc.

It is quite surprising how well sounds are carried through the earth itself, especially in rocky soil. Signals were transmitted in this way at quite an early date. At Fig. 5 the Indians are seen making use of this method of intercommunication. The scout, for instance, tapped a rock, partially buried in the ground, with another stone. At a surprisingly long distance away this sound could be heard by the Indians, whose hearing was extremely sensitive, by placing the ear to the rocky ground. Times without number the approach of men on horseback was heard in this way by the Indians, so that it was often very difficult for the United States troopers to conduct anything like regular warfare, as the savages would hear them coming several miles away and thus be able to circumnavigate them, or get to some little known hiding place.

A mode of signaling known to most of us, but one which dates back to the days of the first locomotive, is that making use of several distinct blasts of the steam whistle as portrayed in Fig. 6. Engineers to-day use this scheme for calling train crews and also for communication with other trains. One, two and three blasts of the whistle have different meanings assigned to them, etc. Locomotive whistles are often used for a signal of distress when the engine happens to be located near a large fire or when a wreck has occurred. In the latter case the whistle is usually tied down, so as to blow steadily until help comes, but at other times it is intermittently tooted.

Signaling wirelessly by means of a reflected ray of sunlight, is illustrated at Fig. 7. This method makes use of an instrument known as the Heliograph. It has been adopted by practically all army signal corps. This arrangement may be utilized without the aid of sunlight, wherever a sufficiently strong source of illumination is available, such as that produced by acetylene or electric light. Some of the army searchlights now built are provided with a shutter arrangement, similar to that fitted on the heliograph, so that long and short flashes of light may be sent out corresponding to the dots and dashes of the Morse telegraph code. Rapid signaling is thus accomplished, as it is possible to manipulate the heliograph shutter as speedily as the common telegraph key and sounder. A probable range for such devices as this may be put down as three to four miles ordinarily, but in most cases it is used for establishing communication between different signal squads or army posts at shorter distances. Signaling by this method can, of course, be carried on over a considerable range, and the more powerful the searchlight or other source of illumination utilized the greater the range.

We come now to the final method of signaling covered by this article on the evolution of wireless telegraphy, which is indicated at Fig. 8. As is well known, for this method of intercommunication there is invariably utilized a large size antenna or aerial, consisting of a number of wires supported by highly elevated masts. The illustration herewith shows roughly the appearance of the trans-Atlantic wireless telegraph station of the Marconi company located at Wellfleet, Mass. This method of signaling without wires has entirely transcended the dreams of wireless telegraphy entertained vaguely by the great scientists and engineers of even two decades ago. Wireless telegraphy in a practical sense and for commercial requirements has only been a reality since the year 1900, but to-day it has been developed to such an extent, involving the use of very high powered stations, that wireless messages may readily be propagated over such distances as 5,000 miles. This is mentioned to show what has been really accomplished, but this is freak work. Generally speaking, common ranges for moderate long distance radio telegraphy is 2,500 to 3,000 miles. There are a few stations working over such distances as 4,000 miles. Marvelous indeed has been the onward and triumphant march of science in the realm of intelligence transmission. Where and when will these wonders of science stop?

VIA "SAYVILLE" TO BERLIN.

The Telefunken station at Sayville, L. I., is one of the most powerful in the world, flashing messages nearly 4,000 miles direct to Nauen, near Berlin.

Located near the ocean and dropped in a mosquito-infested field, the great Telefunken station sprawls over 100 acres. A mile away it looks like a huge spider web, with all its slim poles reaching into the air, interlaced with slender wires. At the gate a watchman is on guard, and all along the way to the building are posted danger signs.

The little low building is rigged on every side with towering poles—antennae as they are called. Five hundred feet high they stand—almost as tall as the Washington monument. From these wires radiate the electric waves that leap across space to Germany. Great blocks of cement, big as corncribs, are set in the ground and to them are anchored the guywires.

Inside the low, one-story building, squatting at the foot of the towers, are 18 men working. Fourteen of these are censors for the United States Government, as for several months the navy has been in control of the Sayville station. Every message must be sent through them and received through them. The Telefunken employes operate the plant, but all messages have to be submitted to the Government censors.

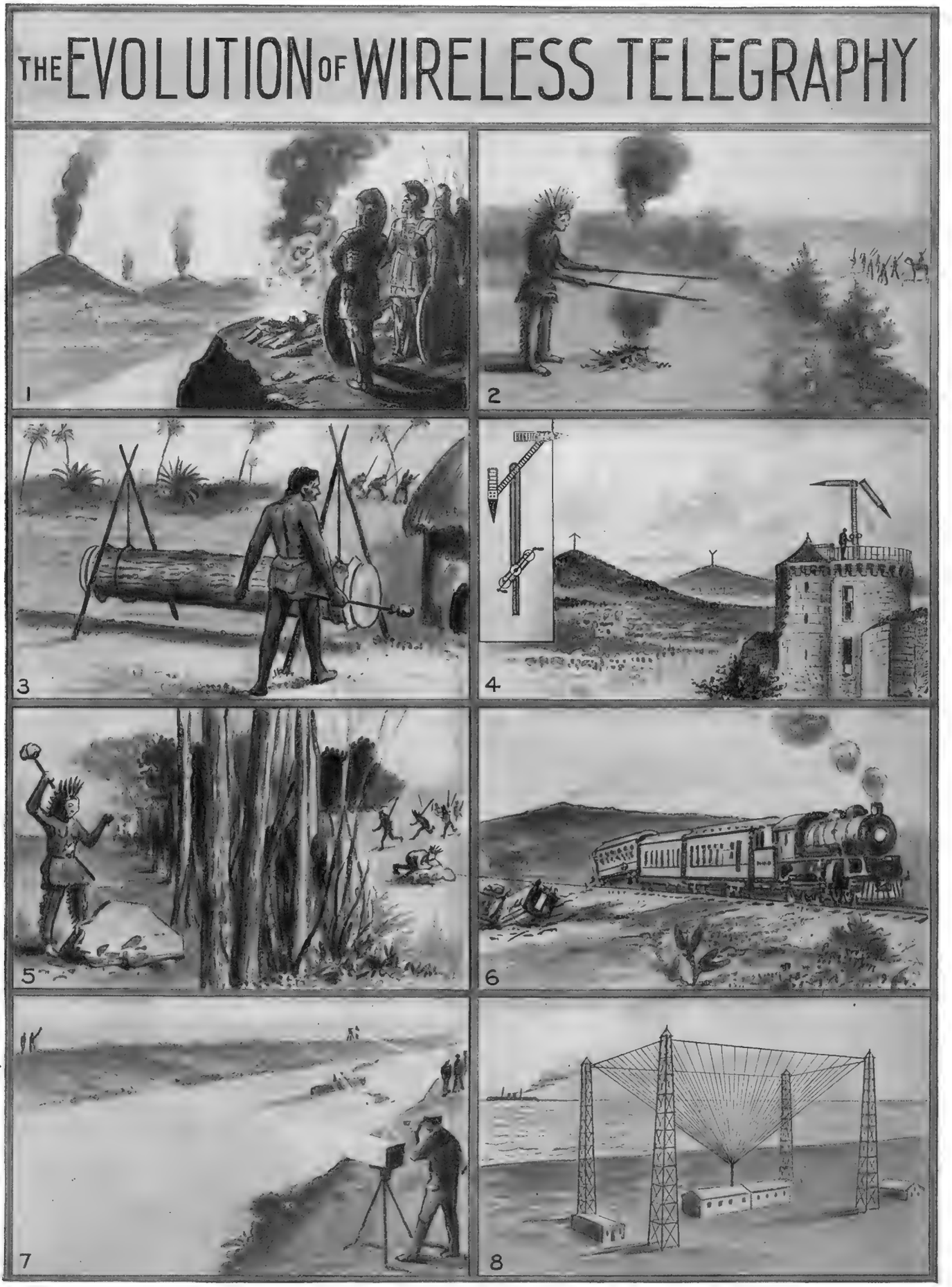
The message is flashed across the Atlantic at the rate of 25 words a minute, but in case of necessity it can go up to 40. The messages go to a small town near Berlin called Nauen, where they are placed on a land wire and forwarded to the capital. The charge for sending a message to Germany is 53 cents a word from anywhere near New York. The 3 cents is the price of the land wire to get it to Sayville.

As soon as the key is touched in America the message is in Germany, the time occupied in crossing being only the fraction of a second. In fact, the message could go around the world seven times in a second.

Every message is censored before it goes out. A Government officer sits there with a blue pencil and if he suspects the message has another meaning than what is on its face he returns it to the sender; or he may paraphrase its meaning, saying the same thing in different words, which would of course upset the code message, if it contained one.

On an average 100 messages a day go out of Sayville for Berlin. Most of these

(*Continued on page* 670.)

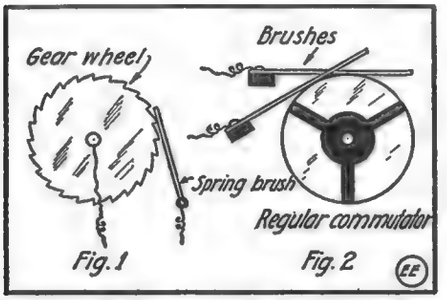


For Explanatory Text, See Preceding Page.

The Reception of Long Damped and Undamped Waves*

By Thomas Appleby

ALTHOUGH it is not generally known there are at least three stations in this section of the country (Philadelphia, Pa.) now using undamped waves for transmission. Two of these stations gen-



Figs. 1 and 2. Two Forms of "Tikker" for Receiving Undamped Waves.

erate the undamped waves with the oscillating arc; while the third makes use of a high frequency generator.

In the ordinary spark station two frequencies are used, one being the radio frequency which determines the wave length and the other the audio frequency which is produced by the rotary or quenched spark gap, and this determines the pitch of the spark as heard at the receiving station.

In an undamped wave transmitting station there should be no audio or spark frequency, as the oscillations which determine the wave length are generated by a high frequency generator of 50,000 cycles or more, or by an oscillating arc which is more or less silent in operation.

When an undamped wave is tuned in at the receiving station and an ordinary crystal detector used there should be no sound in the telephone receivers, as the radio frequency is entirely too high for the human ear. There are exceptions, however, for we can plainly hear the Tuckerton station with a crystal detector, even though they use the high frequency generator; and not only do we hear the actual sending, but we can also hear the reversed sending caused by the compensating wave, due to the manner in which the key is shunted around a few turns of the helix. However, the signals received in this manner are very faint, compared to the great strength of the signals when a tikker is used.

In order to lower the frequency of the current set up by the undamped waves; or, in other words, to produce an audible frequency, it is necessary to break up the incoming current at the receiving station.

This may be accomplished in two ways: First, by the use of a tikker, which consists

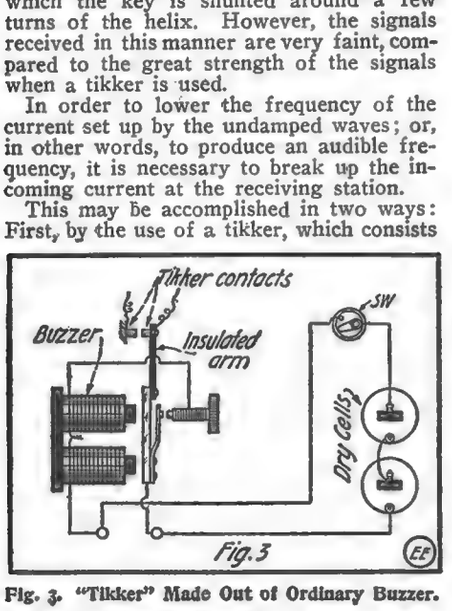


Fig. 3. "Tikker" Made Out of Ordinary Buzzer.

in its simplest form of a rotating gear wheel with a spring held against the teeth; the pitch of the signal being determined by the speed of the tikker wheel (Fig. 1).

Another form of tikker would consist of a revolving commutator, such as is used on small motors, with two copper brushes bearing on the sections and arranged so that the circuit is constantly made and broken by the passing sections of the commutator (Fig. 2). The absence of noise in this form of tikker makes it more desirable than the first. An ordinary electric buzzer may be provided with an extra set of contacts well insulated from the buzzer itself and used as a ticker (Fig. 3). All of these break up the incoming signals into a lower or audible number of vibrations, which can be easily heard in the receivers.

It is not absolutely necessary to use a crystal detector along with the tikker, but is advisable, as the signals come in much louder.

The circuits for use with the tikker and

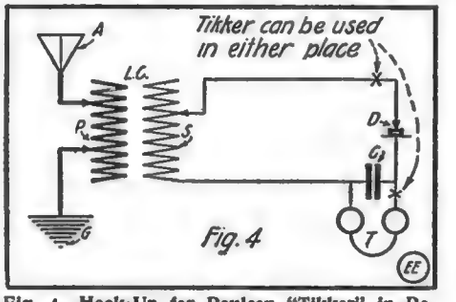


Fig. 4. Hook-Up for Poulsen "Tikker" in Receiving Circuit.

detector are similar to the ordinary receiving circuits. The tikker may be connected in various places in the detector circuit with nearly equal results. It operates satisfactorily when in series with the detector, in

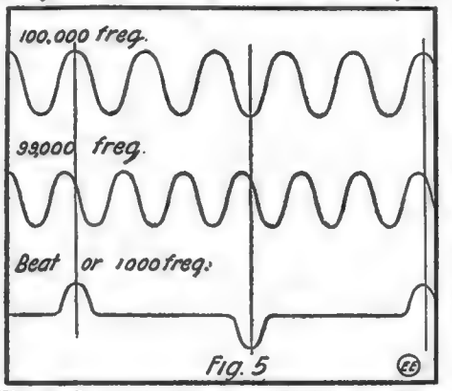


Fig. 5. Demonstrating How "Beats" Are Produced by Two Slightly Differing Oscillators in a Common Circuit.

series with the 'phones, across the stopping condenser, across the variable condenser, or even shunted around the secondary coil.

The second method of lowering the undamped wave frequency is by means of the heterodyne effect, as discovered by Prof. R. A. Fessenden.

When two piano strings are tuned to slightly different tones, a third tone, or "beat," as it is called, will be heard. The piano tuner does not listen to the tone of the strings when tuning a piano, but listens for the "beats," which occur when the two strings are slightly out of tune. The nearer the two strings approach the same tone, the slower or lower the beats become. When the strings are considerably out of tune, the beats are very rapid and produce a high tone of their own.

In much the same manner we produce "beats" in the receiving circuit. The production of these "beats" is called the heterodyne effect. We set up oscillations in the receiving circuit which are slightly different in number than those of the incoming wave. The result is "beats," and the nearer we make our frequency to the incoming fre-

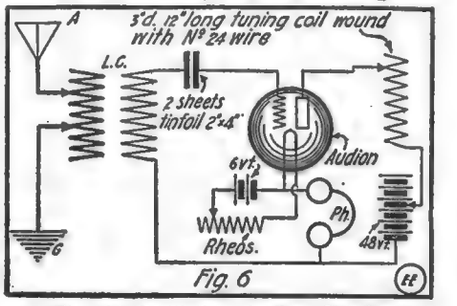


Fig. 6. Oscillating Audion Circuits.

quency the lower we will make the tone of our "beats." If the incoming frequency is 100,000 per second, and we generate 99,000 oscillations per second in our receiving circuit; the difference between the two, or 1,000, would be the frequency or tone of the beats (see Fig. 5). This would sound like the whistle of 1,000 sparks per second, as produced by the 500-cycle quenched gap.

Oscillations may be set up in the receiving circuit by means of a near-by oscillating arc, or by use of an oscillating audion as used in the ultraaudion or Armstrong circuits (see Figs. 6 and 7).

Tuckerton station (W.G.G.) makes use of a high frequency alternator and sometimes the arc for generating undamped waves. Sayville now uses the oscillating arc and Arlington also uses the oscillating arc at times to work with NBA.

Tuckerton can be heard on about 8,500 meters wave length; Sayville is on about 9,000, and Arlington on about 5,000 to 7,000 meters, considering undamped waves.

Tuckerton and Sayville work between 7 p. m. and 2 to 3 a. m.; as a rule, they work for about one hour each, Tuckerton shutting down while Sayville is working, and vice versa. Arlington transmits at times during the evening, and often during the day time.

We have received all these stations on our 300-foot, two wire aerial, in West Philadelphia, although at present we only use half of this length, or 150 feet. The loading coil in series with an ordinary loose coupler consists of a tube four inches in diameter and 12 inches long, wound with No. 24 B. & S. enameled wire. A 43 plate variable condenser is shunted around both the loading and loose coupler primary coil. In the detector circuit we use a 43 plate variable condenser across the secondary

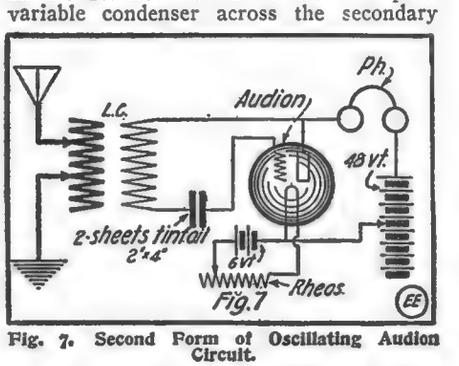


Fig. 7. Second Form of Oscillating Audion Circuit.

which is wound with No. 30 B. & S. silk-covered wire. We found, however, that the 43 plate condenser was unnecessary in the detector circuit and when removed the signals could be tuned in just as strong, pro-

*Paper presented before the Wireless Association of Pennsylvania, Sept. 24, 1915.

vided tight coupling was used. Of course we do not receive efficiently with this arrangement, as the aerial is not balanced for these waves, but simply oscillates, due to

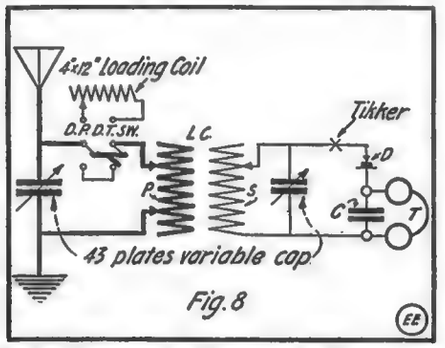


Fig. 8. Hook-Up for Reception of Undamped Waves with "Tikker," Including Loading Coil Cut-Out Switch.

forced oscillations, and sets the loading coil loose coupler primary coil and shunted condenser circuit (which is actually tuned to the desired wave length) oscillating. The detector circuit also probably oscillates, due to forced oscillations from the primary circuit (see Fig. 8).

We are now constructing the proper loading coils to load up all the circuits until we have resonance. The above arrangement is so simple and can be secured with such little additional apparatus that the average amateur will probably be inclined to give it a trial. The signals from Tuckerton, Sayville and Arlington are strong, but when resonance is secured they will be many times stronger.

We are also constructing some loading coils for use in receiving the foreign stations working on as high as 20,000 meters. Petrograd, Russia, is said to use 20,000 meter waves, as are some others. One of the new Marconi stations in New Jersey can be heard testing some evenings on 18,000 meters. They use an audio-frequency or spark system and the crystal detector is all that is necessary. A wireless authority in New York City, and another in Washington, claims that the 20,000-meter foreign stations can be easily received on a 150-foot amateur aerial, and to the experimenter who has tired of listening to the ordinary short wave stations the writer would advise that he get busy and tune in the long wave stations, especially the undamped waves.

THE GROUND LEAD AND ITS PROPER USE.

By Electron.

Not one radio amateur in a hundred is

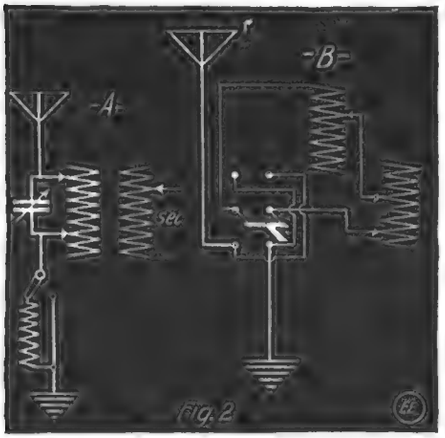


Fig. 2. Diagram of Ground Switch Change-Over for Radio Receiving Set.

aware of the possibilities of increasing his range that lie in his ground lead. It may be properly insulated and grounded, yet they overlook the benefits that may result from a little time and energy spent in making the few changes suggested in these short paragraphs.

First we will consider its length; the shorter it is the higher the amperage that is induced in the secondary circuit, and, correspondingly, the longer it is—within a certain limit—the higher the voltage in the secondary circuit.

Just why this is will be apparent by glancing at Fig. 1, which shows roughly diagrammatically the voltage and amperage characteristics in the open aerial circuit. We will consider a vertical aerial set into oscillation by an incoming wave. When this aerial is swinging in resonance with the incoming wave the induced voltage is greatest at the top and lowest at the bottom or ground connection. Hence, according to Ohm's law, the reverse is true of the current, which is lowest at the top of the aerial and maximum at the ground.

Going one step further, imagine the receiving set connected in at a point in the circuit indicated at A (Fig. 1). The cur-

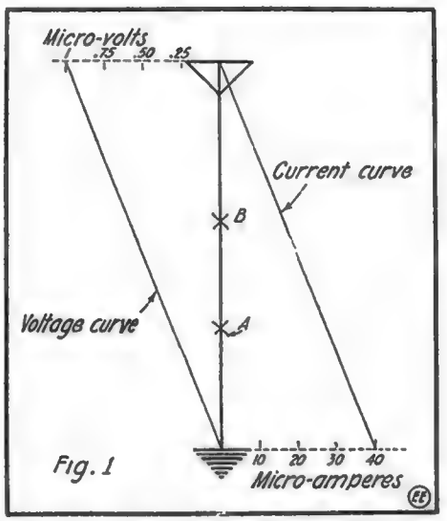


Fig. 1. Approximate Graphical Relation of Current and Voltage in Antenna.

rent here has a comparatively large ampere value and a comparatively small voltage value, therefore amperage predominates in the energy induced in the detector circuit. This condition is best for detectors acting on the thermo-electric principle, such as galena, and the signals will of course be comparatively loud.

The opposite tends to be the case when the set is connected at a point in the circuit indicated at B. Here the voltage predominates and the voltage in the detector circuit will be higher than in the previous case. These conditions are ideal for sets utilizing the audion, for instance.

The above explains the theory, and now we will consider the application of these effects to practise. It is practically impossible to change the connections as mentioned in the foregoing, but two alternatives remain.

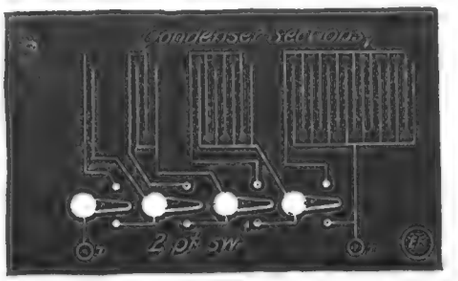
One method (A) that can be utilized to good effect is to install two ground leads, with a switch to change from one to the other. One of these leads should run as straight as possible to the ground connection and the other should possess an inductance, which may consist of about 75 turns of No. 24 C. C. magnet wire wound on a core 4 inches in diameter.

The other method (B) is to install a D. P. D. T. switch to enable one to throw the load coil from the aerial to the ground lead. It is understood if you only use mineral detectors it is unnecessary to have two leads, and if audions are used exclusively connect the load coil in the ground lead permanently.

The diagrams appended show the connections of the switches for the use of those who use both the audion and mineral detectors as receptors.

A SIMPLE VARIABLE CONDENSER SWITCH.

The following is the description of a variable condenser switch which will work on either sending or receiving types. The



Unique Switching Scheme for Adjustable Condenser.

plates are arranged as shown in the diagram and are connected to four two-point switches. The condenser plates can be of tinfoil, separated by paraffin paper for receiving or put on glass with some shellac, for sending types. The whole should be placed in a box, with the switches outside in any convenient place. One more two-point switch and 32 more plates can be added and the capacity is doubled.

Care should be taken not to put all the switches to the right, as it will short-circuit the other instruments.

Contributed by C. J. FITCH.

A TUBULAR VARIABLE CONDENSER.

This condenser may be constructed almost entirely of parts to be found about the average amateur workshop. The dimensions may be varied to suit conditions, but the author has found the following dimensions most satisfactory: Length of outer tube, 5½ inches; diameter of outer tube, 4 inches; length of inner tube, 5½ inches; diameter of inner tube, 3¾ inches.

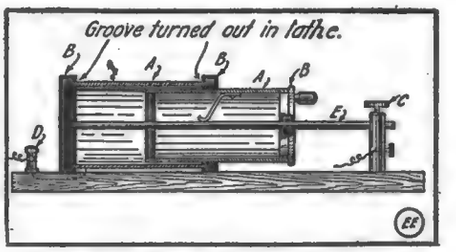
A wire soldered to the bottom makes connection with the outer tube, while connection with the inner one is made by means of a slider of phosphor bronze, which presses on the brass rod as shown in the illustration.

A layer of Empire cloth, or oiled linen, is secured around the inner cylinder by a thin coating of shellac, or, better, beeswax.

The uprights are composed of oak and finished with shellac. The base is best made of slate. This instrument possesses great ease of adjustment, and there is no possibility of a short circuit.

Contributed by

EARL E. NEWLIN.



Home-Made Tubular Variable Condenser.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK TILL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of November, 1915. (Continued.)

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
SECOND DISTRICT.			
2HR	Summerville, Chris. ...	4 Jones Pl., Yonkers, N. Y.	1
2IS	Teets, Albert S.	Hillside Ave., Peekskill, N. Y.	.5
2IJ	Weller, William W.	982 Linton Ave., New York, N. Y.	.5
THIRD DISTRICT.			
3KR	Anderson, Rich'd J.	2510 26th St., N. Wildwood, N. J.	.5
3JC	Ault, Arthur K.	1152 Columbia Ave., Baltimore, Md.	.5
3KS	Bernhard, William	2119 Fairmount Ave., Baltimore, Md.	.5
3KH	Don Bosco Institute	507 S. 9th St., Philadelphia, Pa.	.5
3KT	Elder, Lucius W.	407 Wayne Ave., Wayne, Pa.	.5
3LX	Geiglein, Henry S.	2583 W. Fayette St., Baltimore, Md.	1
3MK	Griscom, Samuel B.	32 Walnut St., Salem, N. J.	.5
3KV	McDowell, A. P., Jr.	41 Carpenter St., Philadelphia, Pa.	.5
3KW	Mehring, Charles, Jr.	414 Reily St., Harrisburg, Pa.	.5
3LV	Podemski, Paul	1602 Beulah St., Philadelphia, Pa.	.5
3LE	Samaha, Edward F.	2 Oriental St., Atlantic City, N. J.	.5
FOURTH DISTRICT.			
4CX	Breck, Charles	50 Logan Ave., Atlanta, Ga.	.5
FIFTH DISTRICT.			
5DK	Coleman, Jess B.	811 17th St., Temple, Texas	.5
5DL	Mount, Robt. H.	Pineville, Ia.	1
SIXTH DISTRICT—None.			
SEVENTH DISTRICT.			
7KH	Adams, Alfred L.	Silverton, Ore.	.5
7LI	Cavender, Howard M.	511 Terry Ave., Seattle, Wash.	.5
7RC	Cook, Richard H.	324 N. I St., Tacoma, Wash.	1
7FK	Gale, Charles W.	111 E. 48th St., Portland, Ore.	.5
7PV	Kraft, Vincent I.	4745 11th Ave., N.E., Seattle, Wash.	1
7MN	Nelson, Mikko	Deep River, Wash.	.5
7LD	Noel, Lionel S.	Snohomish, Wash.	.5
7CO	O'Dell, Charles M.	7856 Stroud Ave., Seattle, Wash.	.5
7PF	Rasmussen, Viggo P.	1215 Hudsn St., Pt Townsend, Wash.	.5
7DW	Willis, Cecil D.	1316 Columbia St., Seattle, Wash.	.5
EIGHTH DISTRICT.			
8HL	Blake, F. B.	Cattaraugus, N. Y.	.5
8UJ	Boardman, Thos. H.	813 Lincoln Ave., Port Huron, Mich.	.5
8CN	Burton, James F.	345 Whitman Ave., Bloomsburg, Pa.	1
8IU	Eaton, Floyd W.	1901 Milton Ave., Solvay, N. Y.	.5
8PE	Fisher, George C.	546 Utah St., Toledo, Ohio.	.5
8MZ	Goodrich, Harry	443 North Ave., Girard, Ohio.	1
8VU	Kane, Wm. C., Jr.	221 Reservoir Ave., Rochester, N.Y.	.5
8AMB	Koch, Frank	3402 Highland Ave., Cincinnati, O.	.5
8GO	Kohnitz, Harvey F.	104 Maple Ave., Plymouth, Mich.	.5
8JG	Lord, Harry R.	531 Beach Ave., Cambridge Spgs, Pa.	1
8OW	Mitchell, Edward H.	539 Main St., Findlay, Ohio.	.5
8LO	Nabring, Franklin J.	52 Foster Ave., Norwalk, Ohio.	.5
8TI	Newbold, James L.	111 Orchard St., Solvay, N. Y.	.5
8JH	Nichols, Raymond B.	Cattaraugus, N. Y.	.5
8MK	Vonderhaar, Elliott	123 Valencia Ave., Cincinnati, Ohio.	.5
8VQ	Ziska, Alfred	7704 Brinsmade Ave., Cleveland, O.	.5
NINTH DISTRICT.			
9WL	Bierbach, Werner	655 S. Delaware Ave., Milwaukee.	1
9NO	Coquilette, Glenn E.	117 Hutchins St., Woodstock, Ill.	.5
9WN	Ferdinand, Harry P.	1315 School St., Rockford, Ill.	.5
9KB	Forbes, Henry C.	3532 11th Ave., S. Minneapolis	.5
9WO	Garrett, Sherman	504 W. Wash. St., Champaign, Ill.	1
9WI	Kelley, Eugene V.	1311 W. Maple Ave., Independence, Mo.	.5
9IP	Nell, Edward, Jr.	2023 Talbott St., Indianapolis, Ind.	.5
9IG	Reeder, Vern K.	2705 Highland Pl., Indianapolis, Ind.	1
9SV	Ruzek, Oscar E.	Flat Rock, Mich.	.5
9WM	Smith, Stanley	1552 E. 61st St., Chicago, Ill.	.5
9IM	Smith, Wallace W.	13 Eastover Park, Louisville, Ky.	1
9WJ	Struver, Harold W.	1218 Lafayette St., Ft. Wayne, Ind.	.5
9CB	Taferl Electric Co.	236 W. Jefferson St., Louisville, Ky.	1
9JV	Teetor, Macy O.	Hagerstown, Ind.	.5
9WK	Thomas, Carroll W.	746 16th St., Milwaukee, Wis.	.5
9FY	Zimmerman, Clinton J.	117 S. Washington St., Buquoin, Ill.	1

NOTE.—Hereafter, all power will be stated in kilowatts instead of watts. All stations using power up to and including 500 watts will be rated as .5 kilowatt stations; all stations using power above 500 watts up to and including 1,000 watts will be rated as 1 kilowatt stations. This will be carried out in the List of Radio Stations of the United States, 1916 edition.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of December, 1915.

Call signal	Owner of station.	Location of station.	Power kilowatts.
FIRST DISTRICT.			
1JO	Allen, George H.	16 Bacon St., Waltham, Mass.	.5
1WW	Bailey, Philip A.	64 Washington St., Middletown, Conn.	1
1EA	Barker, Gulian D.	19 Channing St., Newport, R. I.	.5
1AAZ	Bates, Roger E.	184 Pine St., Wollaston, Mass.	1
1ABA	Beattie, Robert	21 County Road, Everett, Mass.	.5
1ABK	Bent, Arthur E.	84 Commonwealth Ave., Boston, Mass.	.5
1ABS	Bliss, Donald H.	12 Dean St., Attleboro, Mass.	.5
1RB	Brackett, Walter F.	24 Maple St., Stoneham, Mass.	.5
1ABJ	Brockington, Harry G.	69 Lincoln St., Laconia, N. H.	.5
1LH	Burke, Henry M.	59 Chatham Road, Everett, Mass.	.5
1ABL	Campbell, John A.	9 Fairlee St., Somerville, Mass.	.5
1ABV	Carr, Albert H.	8 Decatur St., Worcester, Mass.	.5
1ABT	Coolikoff, Jacob.	112 Broadway, Chelsea, Mass.	.5
1ABC	Clark, Charles V.	25 Pierce Ave., Beverly, Mass.	.5
1FD	Crie, Oscar H.	Castine, Maine	.5
1ABQ	Crosby, Leslie W.	12 Elmwood Road Swampscott, Mass.	.5
1AAU	Donahue, Frank J.	32 Whittier St., Lynn, Mass.	.5
1ABO	Donnelly, George F.	South Meriden, Conn.	.5
1ID	Eddy, James C.	489 Common St., Belmont, Mass.	.5
1ABD	Engel, Richard B.	35 5th St., Medford, Mass.	.5
1ABF	Fitch, Clinton	22 Cottage Pl., Waterbury, Conn.	1
1VJ	Frank, Louis G.	21 Summit Ave., Brookline, Mass.	.5
1AH	Goularte, Manuel L.	R. F. D., Fairhaven, Mass.	.5
1AAS	Gould, Clyde S.	123 Hamilton Ave., Lynn, Mass.	.5
1ABG	Graves, William S.	Sunapee, N. H.	.5
1UA	Guilmette, Edward J.	343 Mason St., Woonsocket, R. I.	.5
1KY	Hallett, Charles E.	28 Norcross Ter., Lynn, Mass.	.5
1ABU	Hertz, Wm. F. C., Jr.	57 S. Water St., New Haven, Conn.	.5
1EX	Keyes, Perley E.	71 School St., Sanford, Maine	.5
1SJ	Lynch, Sherman W.	26 Abbott St., Beverly, Mass.	.5
1TZ	McHenry, Albert T.	64 Cutter St., Melrose, Mass.	.5
1ABV	McKinney, Roscoe H.	Thomaston, Maine	.5
1SA	Mercer, W. Roy	34 Webster St., Allston, Mass.	.5
1ABH	Mooradian, Arom P.	144 Lawton Ave., Lynn, Mass.	.5
1AAM	Murray, James J.	28 Wensley St. Boston Mass.	.5
1SG	Nickerson, Edgar W.	16 Atlantic Ave., Beverly, Mass.	.5
1ABP	Pope, Donald R	2 Winthrop, Danvers, Mass.	.5
1RK	Prescott, Earle M.	6 Lincoln St., Stoneham, Mass.	.5
1SZ	Reid, Ralph A.	8 Cedar St. Wakefield, Mass.	.5
1EU	Seibert, Leroy G.	Berlin, Conn.	.5
1MQ	Sherman, Joseph E.	349 Tremont St., Boston, Mass.	.5
1RC	Simmons, Minot A.	124 Beech St., Roslindale, Mass.	.5
1AAX	Snow, David F.	15 Lincoln St., Arlington, Mass.	.5
1ABR	Stevens, Charles L.	19 Lincoln St., Stoneham, Mass.	.5
1AAP	Stevens, Louis W.	394 Riverway, Boston, Mass.	.5
1ABE	Taylor, Frederic W.	30 S. Main St., Attleboro Mass.	.5
1MG	Turner, Edwin E.	72 Wyman St., Jamaica Plain, Mass.	.5
1HP	Wallace, Wm. H.	30 Hastings St., Cambridge, Mass.	.5
1ABI	Wells, Herbert A.	32 Nelson St., Dorchester, Mass.	.5
1NR	Wetherell, Fred L.	37 Peck St., Attleboro, Mass.	.5
1ABZ	White, I. Davis.	Peterboro, N. H.	.5
SECOND DISTRICT.			
2BT	Adams, Earl F.	1048 Julia St., Elizabeth, N. J.	.5
2JN	Atwater, Charles K.	40 Oakwood Av., Up. Montclair, N. J.	.5
2AHS	Bergner, James A.	206 High St., Brooklyn, N. Y.	.5
2ME	Booth, Sherman F.	30 Center St., New York, N. Y.	.5
2AHR	Byrne, William	85 N. 120th St., Rockaway Pk., N. Y.	.5
2JA	Carruthers, David	135 Waverly Pl., New York, N. Y.	.5
2FV	Foster, Dudley E.	423 4th Ave. Neward, N. H.	.5
2JH	Fricke, Wm. B.	156 N. Arlington Av., E. Orange, N. J.	.5
2MC	Garity, Wm. E.	324 Reid Ave., Brooklyn, N. Y.	.5
2RR	Haight Russell P.	18 Spruce St., Bloomfield, N. J.	1
2NC	Katz, Frederick.	1464 Seabury Pl., New York, N. Y.	.5
2JF	Lockwood, Nelson W.	237 Prospect St., E. Orange, N. J.	.5
2GP	McClintock, Ralph W.	125 High St., Nutley, N. J.	.5
SECOND DISTRICT.			
2GO	Mulligan, Harry G.	62 Chestnut St., Albany, N. Y	.5
2UV	Oliver, Geo. E.	511 Ave. A., Bayonne, N. J.	.5
2JP	Pruden, Harold M.	142 N. 15th St., E. Orange, N. J.	.5
2JI	Ruhlmann, Ernest R	97 W. 34th St., Bayonne, N. J.	.5
2KQ	Schaefer, Regnell C.	185 N. 16th St., East Orange, N. J.	.5
2JB	Smith, Clarence B., Jr.	1017 South Ave., Westfield, N. J.	1
2UV	Squire, Milford.	122 Guion Ave., Richmond Hill, N. Y.	.5
2AQ	Wak, Henry.	82 17th Ave., Newark, N. J.	.5
THIRD DISTRICT.			
3OJ	Barron, John H., Jr.	3022 Abell Ave., Baltimore Md.	.5
3WH	Berkeley, Kenneth H.	3422 Center St., N. W., Wash., D. C.	.5
3AAJ	Blair, C. Drewry.	1804 Hanover Ave., Richmond, Va.	.5
3AEM	Booz, Walter N.	237 W. Pine St., Wildwood, N. J.	.5
3ADA	Bott, James M.	1011 W. Cumberland St., Phila., Pa.	.5
3OH	Bryan, John D.	1927 S. Salford St., Phila., Pa.	.5
3AAG	Carroll, Louis, Jr.	26 S. New Jersey Av., Atlantic C., N. J.	.5
3WI	Darnell, Albert H., Jr.	129 S. Penna. Ave., Atlantic City, N. J.	.5
3ADL	Ellis, Edmund K.	Bethesda, Md.	.5
3AKE	Enslin, Louis R.	1731 N. 21st., Phila., Pa.	.5
3MT	Gardner, Wm. L.	1612 N. 4th St., Harrisburg, Pa.	.5
3RO	Gravely, Willis T.	854 Main St., Danville, Va.	1
3MZ	Jodry, Ray S.	Quincy, Pa.	1
3WW	Keller, Paul A.	13th St., and Lehigh Ave., Phila., Pa.	.5
3SQ	Kupp, Clarence L.	451 Lincoln Ave., Pottstown, Pa.	1
3UB	Lamb, Roland H.	1131 Gorsuch Ave., Baltimore, Md.	.5
3OA	Lentz, Arthur F.	18 Fairview St., West Catasasqua, Pa.	.5
3UE	Lindauer, Herman E.	3409 Piedmont Ave., Baltimore, Md.	.5
3QE	Long, Perry H.	133 Runnymede Ave., Wayne, Pa.	.5
3NR	Maul, Gilbert E.	Chatham, N. J.	.5
3AAP	Roehm, John A.	666 Union St., Lancaster, Pa.	.5
3VO	Schall, John R.	1318 Turner St., Allentown, Pa.	.5
3QA	Stevens, Lewis D.	5224 Delancey St., Phila., Pa.	.5
3AAC	Swartz, French V.	26 S. N. J. Ave., Atlantic City, N. J.	.5
3AAY	Wagner, Laurence E.	6077 Allman St., Philadelphia, Pa.	.5
3OR	Walker, Donald R.	552 Kohn St., Norristown, Pa.	.5
3OQ	Welke, Paul L.	39 S. Stricker St., Baltimore, Md.	.5
3WG	Worley, Robert A.	940 Carteret Ave., Trenton, N. J.	.5
FOURTH DISTRICT.			
4CZ	Ashley, Robert C.	738 4th Ave., N., St. Petersburg, Fla.	1
4CY	Cooper, Frank P.	717 S. Edison St., Tampa, Fla.	.5
4DD	Emory University.	Oxford, Georgia.	1
4DA	Fogarty, John J.	707 Azeele St., Tampa, Fla.	1
4DB	Lesley, John L	114 Hyde Park Pl., Tampa, Fla	.5
4DE	Moore, Thomas H., Jr.	321 N. Spring St., Pensacola, Fla.	.5
4DC	Peer, Emmitt E.	419 Duval St., Jacksonville, Fla.	1
FIFTH DISTRICT.			
5DN	Collins, Wm. A.	328 Arabella St., New Orleans, La.	.5
5BO	Floyd, Preston M., Jr.	213 E. Blvd., Baton Rouge, La.	.5
5DP	Geren, A. Blanchard.	1815 W. Gary St., Shreveport, La.	.5
5DM	Reid, Kenneth M.	1001 Columbus Ave., Muskogee, Okla.	.5
5DO	Wolover, Wm. H.	624 Eastside Blvd., Muskogee, Okla.	.5
SIXTH DISTRICT.			
6GA	Andrews, Gaylerd.	4734 Shattuck Ave., Oakland, Cal.	.5
6DV	Bales, Edward M.	1006 N. Main St., Napa, Cal.	.5
6CB	Bascom, Carleton V.	1020 E. 27th St., Los Angeles, Cal.	.5
6EW	Bertin, Edwin.	017 Ave. A, Coronado, Cal.	.5
6BE	Birkeland, Andrew.	22 Fairmount St., San Francisco, Cal.	.5
6BD	Carter, E. Stewart.	1639 Formosa Ave., Los Angeles, Cal.	.5
6JP	Clark, John H.	316 E. 55th St., Los Angeles, Cal.	.5
6CF	Curtis, Burbank.	519 E. 9th St., Long Beach, Cal.	.5
6DE	Davidson, James D.	462 W. Grand Ave., Pomona, Cal.	.5
6RD	Deardorff, Ralph W.	202 Cypress Ave., Santa Ana, Cal.	1
6DJ	Duffey, Guy H.	1622 W. 24th St., Los Angeles, Cal.	.5

(To be continued.)

THE CONSTRUCTOR

The Use and Construction of a Decremeter

By Milton B. Sleeper

WHILE most experimenters are familiar with the measurements commonly made in radio work, not many understand the measurement of "decrement." Since the sharpness of the radiated wave depends upon the decrement (or damping), this value must be measured if the tuning characteristics of a transmitter are to be predetermined or made known. To reduce the interference as far as possible, the law requires that the logarithmic decrement shall not exceed 0.2. Several kinds of decremeters* have been developed, but the one described here is the simplest. This type was first used by the Marconi Co.; the formula on which its operation depends is due to V. Bjerknes. The construction of the instrument will first be taken up; then its use.

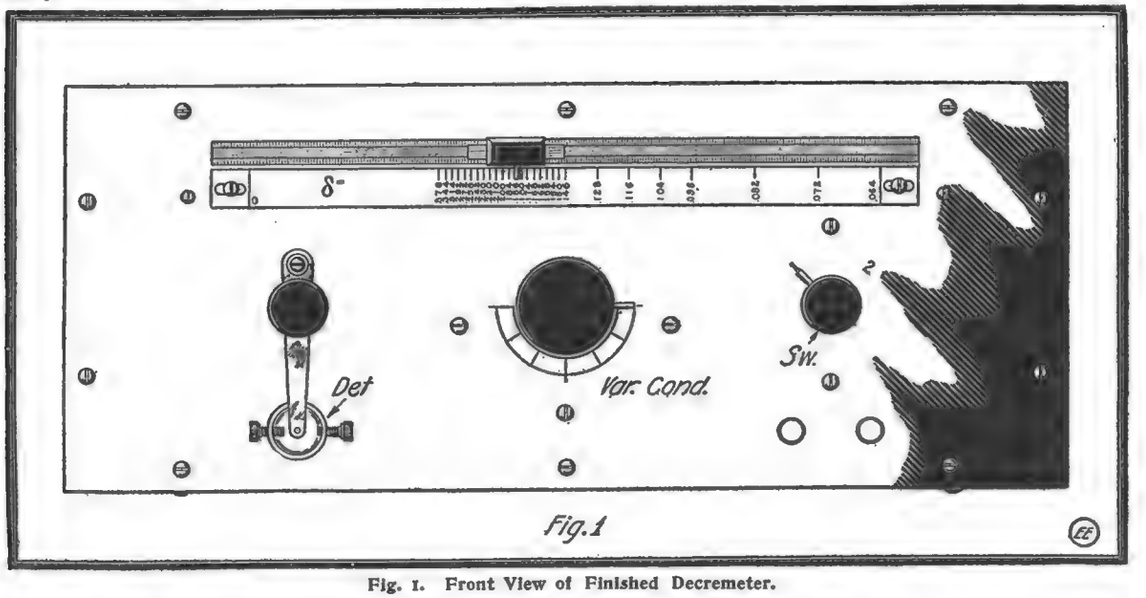


Fig. 1. Front View of Finished Decremeter.

Construction of the Decremeter.

Fig. 1 shows the front of the instrument, while Fig. 2 gives the connections. At the left of the front view is the detector. Any mineral is suitable if it holds its adjustment well. The handle in the center is for the variable condenser. At the right is the switch, represented in the diagram of connections by the numbers 1, 2, 3, 4, 5, 6. Below the switch are binding posts for connecting any suitable 'phones. Across the top is arranged a slider which projects through the slot in the hard-rubber front. The damping decrement can be read directly from the scale. If it is desired the decremeter can be calibrated at the Bureau of Standards, Washington, D. C., but if the decremeter is carefully constructed it will be accurate enough for all purposes. Although it is far better to keep all the parts inclosed, this instrument will work as well if the essential parts are made according to the drawings, but mounted on a plain base.

The Variable Condenser.

The condenser is of the rotary type and of about .0005 mfds. capacity. It is much better in most cases to buy a condenser than to make one. However, the home-made one described here will be satisfactory if the instructions are closely followed. A list of parts is given to help the builder in getting the material ready. From perfectly flat No. 25 gauge aluminum sheet, cut out 10 pieces 2½x1½ inches. These are for the rotary plates. On two mark out the shape of the plates as shown by 17 in Fig. 3. Clamp the stack of plates between two blocks of wood, the marked pieces on the outside. Using these as a guide, cut along the lines with a fine hand jig-saw, well lubricated with kerosene. Drill the holes for the shaft, too, while the plates are still clamped. From rectangles 3x1½ inches cut out the nine thin stationary plates and the two thick ones, acccording to the drawings. Drill the holes around the edges, but

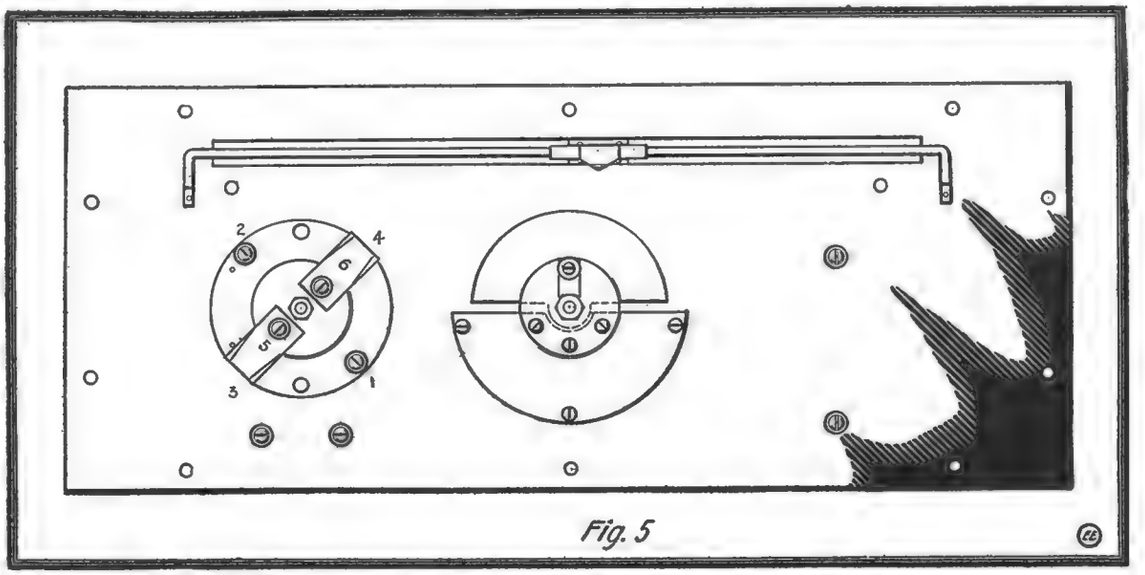


Fig. 5. Rear of Decremeter Switch Board, Showing Slider, Change-Over Switch, Etc., in Position.

*This decremeter was actually built and checked against a standard instrument. With a little care a faithful duplicate can be constructed. —EDITOR.

do not drill the holes for the bearings in the thick plates. If there are any burrs on the plates, rub them off with emery cloth. Washers can usually be purchased. They must be between 0.063 and 0.062 inches in thickness. Test each one with a micrometer. In drilling the bearings, 14 and 15, clamp them to the thick plates and drill the holes in all of them at the same time; otherwise the bearings will not be in alignment, and the plates will touch. Now tap the holes for the screws, 7, which hold the bearings to the thick plates.

When the stationary plates are finished assemble them on the screws, 8. The ends of the pieces 11, which have the smaller holes, go on the screws 8 to keep the plates tight; the ends with the larger holes are for the screws 7, which hold the condenser to the front of the case. The threaded washers, 9, are to hold the rotary plates in position on the shaft. To make sure that both sets of plates have been tightened up the same amount, try the edges of the assembled rotary plates against the assembled stationary ones. Finally, slip the rotary plates between the stationary ones, put the bearings on the shaft, and screw them down in place. When it is time to put the condenser on the hard-rubber front bend the spring, 1, to a bow shape. It belongs on the shaft between the front and the handle. This spring, pressing against the handle, will hold the plates in any position. The nuts, 6, hold the plates from being pulled out of alignment by the spring. In the side view of the assembled instrument, Fig. 4, the complete condenser is clearly shown. The connecting wires have been omitted to make the drawing clearer. Fig. 5 shows the condenser in position on the back of the hard-rubber front. The connection wires are left out in this drawing also.

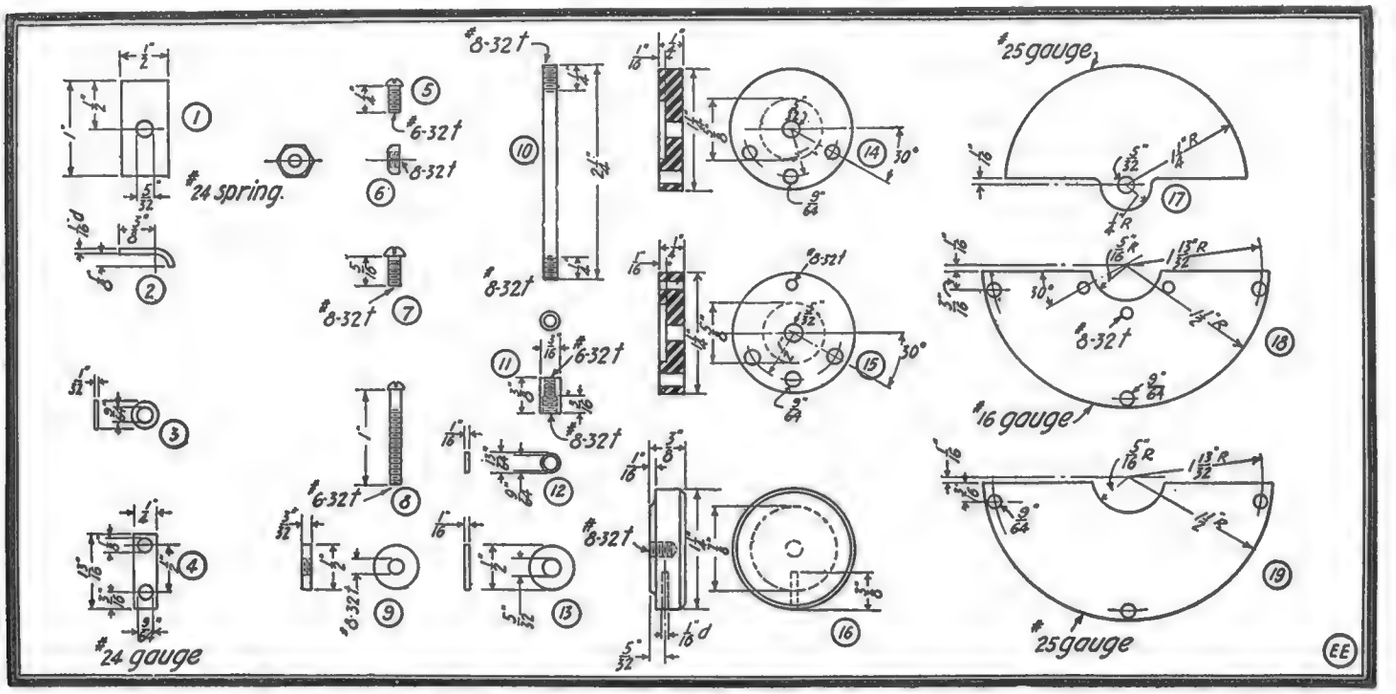


Fig. 3. Details of Decremeter Variable Condenser Parts.

The Inductance Coils.

The inductance coils and contact slider are depicted in detail in Fig. 6. Wind the long coil, 32, with No. 22 double cotton covered copper wire. By soldering a piece of copper foil to the bared wire take taps at the 26th and 52d turns. Wind the smaller coil with 26 turns of No. 22 double cotton covered copper wire. The completed coils are shown in Fig. 4 as they appear when held in place by the straps 40.

Be very careful in laying out the scale 45. Divide the 8-inch space into 100 equal parts.

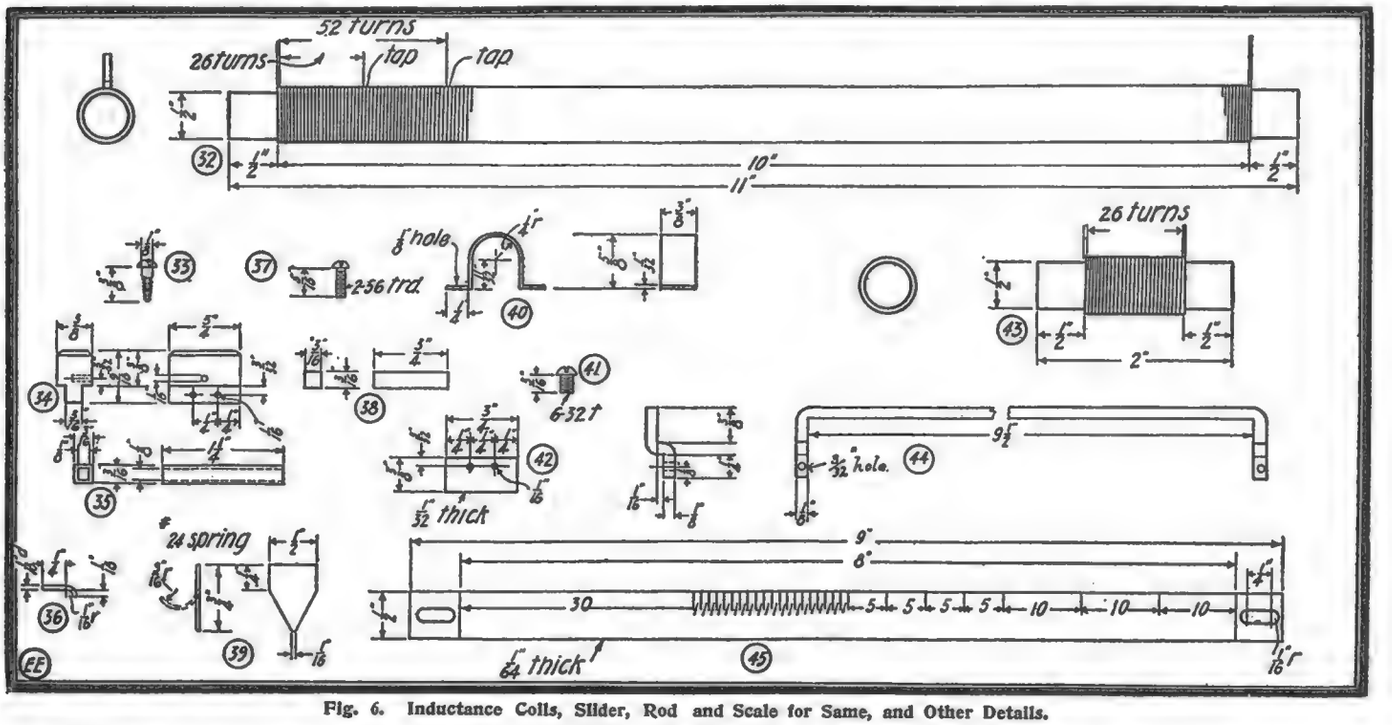


Fig. 6. Inductance Coils, Slider, Rod and Scale for Same, and Other Details.

Then make the divisions for the *decrement readings* as given in the table below:

Number of Graduation Marks on the Scale with Decrement Readings.

Scale.	Decrement.	Scale.	Decrement.	Scale.	Decrement.
30	0.378	40	*0.200	49	0.159
31	0.344	41	0.194	50	0.146
32	0.314	42	0.186	55	0.123
33	0.292	43	0.180	60	0.116
34	0.272	44	0.174	65	0.104
35	0.258	45	0.168	70	0.096
36	0.242	46	0.162	80	0.082
37	0.230	47	0.158	90	0.072
38	0.220	48	0.154	100	0.064
39	0.210				

*Legal limit.

When the scale is in position on the hard-rubber front move it until the pointer is on the zero mark, when the slider contact is on the 26th turn of the larger inductance. This must be done carefully if the meter is to be accurate.

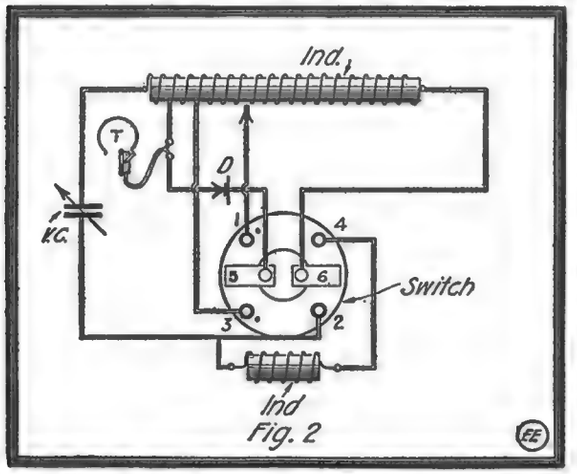


Fig. 2. Wiring Diagram for Parts of Decremeter.

This makes a place for the narrow part of the slider handle, 34, to fit in. Solder the contact, 39, to the bottom of the tube. Now fasten the handle to the slider by means of escutcheon pins or small rivets, put through the holes in the handle and the side pieces 42. Fit the pointer, 36, tightly in the hole of the handle. Be sure to put the completed slider on the rod, 44, before bending the rod in the shape indicated by the drawing. Make sure, also, that the contact is on the right side of the rod. These parts finished, we may start constructing the change-over switch.

[*In the second part of this paper on the construction of a decremeter Mr. Sleeper explains how to use same for measuring wave length, decrement, etc. Don't miss it!—Ed.*]

WAVE LENGTH AND DAMPING.

It is a little known fact that the Government pays little or no attention to a highly damped wave under 200 meters, whereas it reprimands and punishes amateurs who use a wave length in excess of 200 meters. Select the lesser evil to avoid fines. However, for maximum range the decrement should be kept down.

LIST OF PARTS.

Drawing Number	Name of Part	Size	Pieces	Material
1	Spring to go on shaft under handle	1" x ½" x 24 gauge	1	Spring brass
2	Pointer for handle	9/16" x 1/16" diam.	1	Brass
3	Washers to hold connection wires	1/32" x 5/16" diam. 9/64 hole	2	Brass
4	Connection piece for bearing	13/16" x ¾" x 24 gauge	1	Brass
5	Screw for making connection to No. 4	¼", 6-32 thread	1	Brass
6	Nuts to adjust plates	8-32 thread	2	Brass
7	Screws to fasten bearings to outside plates	5/16", 8-32 thread	6	Brass
7	Screws to fasten No. 11 to front of case	5/16", 8-32 thread	3	Brass
8	Screws to hold stationary plates together; goes in No. 11	1", 6-32 thread	3	Brass
9	Washers to hold rotary plates	3/32" x ½" diam. 8-32 T	2	Brass
10	Shaft for rotary plates	2½", 8-32 thread	1	Brass
11	Pieces to hold stationary plates to front	⅜" x 3/16" diam. 8-32 and 6-32 thread	3	Brass
12	Separators for fixed plates	1/16" x 13/64" diam. 9/64" hole	30	Brass
13	Separators for rotary plates	1/16" x ½" diam. 5/32" hole	9	Brass
14	Bearing nearer front of case	¼" x 1¼" diam.	1	Hard rubber
15	Bearing at back	¼" x 1¼" diam.	1	Hard rubber
16	Handle	⅜" x 1¼" diam.	1	Hard rubber
17	Rotary plates	25 gauge, 2½" diam.	10	Aluminum
18	Outside stationary plates; fasten bearings to them	16 gauge, 3" diam.	2	Aluminum
19	Inside stationary plates	25 gauge, 3" diam.	9	Aluminum
20	Nuts to screw on either side of No. 30	8-32 thread	2	Brass
21	Pointer for handle	5/16" x 1/16" diam.	1	Brass
22	Switch contacts	1" x ½", 24 gauge	2	Spring brass
23	Spring to go under handle	1" x ½", 24 gauge	1	Spring brass
24	Washers for connections	1/32" x 5/16" diam. 5-32" hole	12	Brass
25	Pins to stop contacts	⅜" x 1/16" diam.	2	Brass
26	Screws to hold No. 31 to front of case	⅜", 8-32 thread	2	Brass, round head
27	Screws to hold connections	¼", 8-32 thread	6	Brass, round head
28	Shaft	1", 8-32 thread	1	Brass
29	Handle	⅜" x ¾" diam.	1	Hard rubber
30	Movable contact holder	⅜" x 1¼" diam.	1	Hard rubber
31	Stationary contact holder	¼" x 2 5/16" diam.	1	Hard rubber
32	Core for large coil	11" x ⅛" diam.	1	Well-seasoned wood
33	Screws to fasten coil holders to case	⅜" x ⅛" diam.	8	Brass
34	Handle of slider	⅜" x 9/16" x ⅜"	1	Hard rubber
35	Tube for slider	1¼" x ⅛" sq. i.d. 3/16" sq. o.d.	1	Brass
36	Pointer for slider handle	⅜" x 1/16" diam.	1	Brass
37	Screws to fasten slider rod to front of case	5/16", 2-56 thread	2	Brass, round head
38	Support for slider handle	¾" x 3/16" x 3/16"	1	Brass
39	Contact for slider	¾" x ½", 24 gauge	1	Spring brass
40	Coil holders	2" x ⅜" x 1/32"	4	Brass
41	Screws to hold scale to front of case	3/16", 6-32 thread	2	Brass, round head
42	Pieces to hold slider handle	¾" x ⅜" x 1/32"	2	Brass
43	Core for small coil	2" x ½" diam.	1	Seasoned wood
44	Slider rod	11" x ⅛" x ⅛"	1	Brass
45	Scale	9" x 1½" x 1/64"	1	Celluloid
46	Front of case	12¾" x 5½" x 3/16"	1	Hard rubber
47	Back of case	11¾" x 4½" x ⅜ x ⅜"	1	Mahogany
48	Top and bottom of case	12⅜" x 2 11/16" x ⅜"	2	Mahogany
49	Ends of case	2 10/16" x 4½" x ⅜"	2	Mahogany

To assemble the slider, first solder the piece 38 on the middle of the tube 35. To opposite sides of 38 solder the pieces 42.

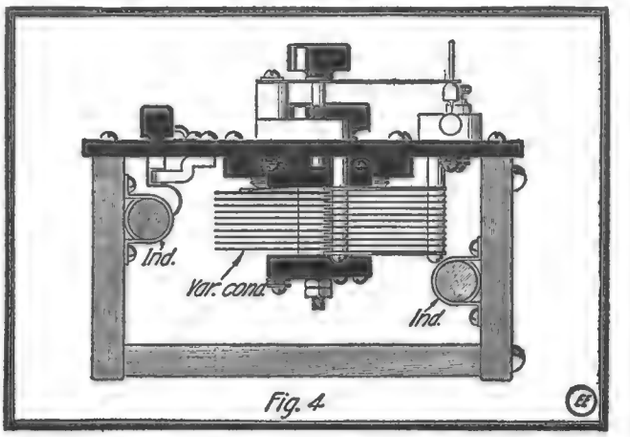


Fig. 4. End View of Decremeter with Cabinet Board Removed.

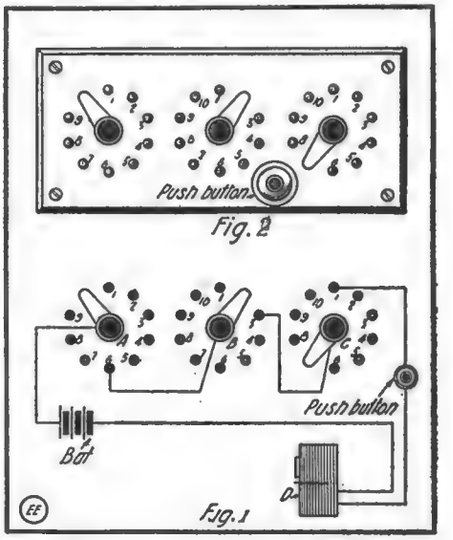
AN ELECTRIC COMBINATION LOCK.

A secret electrical lock is frequently desired on cupboards, little closets and shop doors to keep out undesirable parties. The common method of opening these locks is to use secret contacts, such as two nails, the circuit being closed by a coin or piece of metal.

The lock herewith described has many of the advantages of the above, but is in the form of a combination and can be opened by no one save those who know the prearranged setting of the lock.

The materials needed are 3 switch levers, 30 contact points, 1 push button, 2 or 3 good dry cells and an electric door opener. The circuits and wiring diagram are shown in Fig. 1. A, B and C are the switch levers. Ten contacts are used per switch and arranged on a 1-inch board, 8½x4½ inches. After the levers and contacts are arranged the combination is to be decided upon and hooked up accordingly. In the illustration the combination is 6-3-1. It will be seen that unless switch lever A is on contact 6, switch lever B on contact 3 and switch lever C on contact 1, it will be impossible, upon pushing the button, to open the door upon which the electric lock D is fastened. A great variety of combinations can be had, it being possible to arrange 1,000 different settings with the scheme illustrated.

The appearance of the finished device will be as shown in Fig. 2. It should be screwed, or preferably, bolted, to the door upon which it is placed. All wiring is taken to the inside of the door to prevent anyone meddling with the circuits.



Handy Electric "Combination" Lock for Drawers, Tool Boxes, Etc.

Contributed by A. R. DARLING.

An Electro-Magic Skull

By Homer Vanderbilt

MOST readers of this journal are undoubtedly familiar with the "rapping skull" used by stage magicians, but are possibly doubtful as to how it really works. Several of these schemes

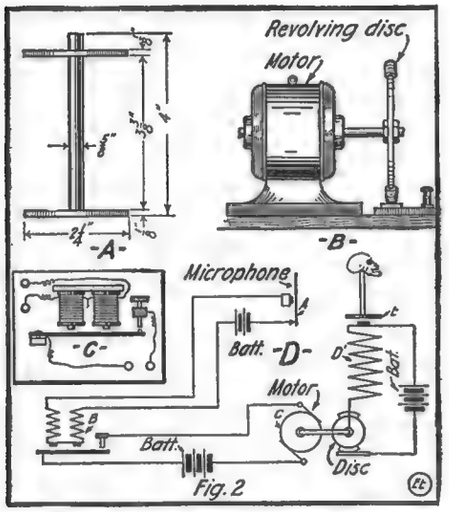


Fig. 2. Circuit Arrangement for the Mystic Skull.

have been developed by different workers in the field, and one of these is herewith described in detail.

The general principles upon which this trick works are as follows: A sensitive microphone, A (Fig. 1), of the *carbon ball type,* is connected in circuit with a relay, B (see also Fig. 2, D), and its armature circuit is linked with a motor, C, and battery. Upon the motor shaft a proper circuit breaker is placed and the latter is connected in series with a powerful electro-magnet, D^1, actuating an iron armature, E, which is connected to a rod, F, operating lever G, which is fastened to the (balanced) lower jaw of the skull, as perceived. Now, when you speak or produce any sounds near the instrument, the microphone will be disturbed, operating the relay, which will connect and work the motor, and in turn the circuit breaker. Consequently the electro-magnet D^1 is put in operation and the result is that the jaw is pulled up by the action of the rod F, actuated by the magnet. When the current is released the slightly overbalanced weight of the jaw will cause it to drop back. The arrangement herewith shown will only cause a double rap of the jaw, but the number of them may be varied by increasing the number of segments on the circuit breaker.

The writer will unfold the details of his apparatus and thereby the experimenter will be enabled to build such a device for amusing his friends. It is certainly very amusing to witness the astonishment of the visitors when the skull is operated.

The constructional details of the individual apparatus are shown in Fig. 2. The electro-magnet "A" is made to size, as perceived, and is fully wound with No. 22 B. & S. copper magnet wire. The circuit breaker "B" consists of a disc revolved by a motor and which makes contact with a brass strip located at the bottom of the base, as depicted. The relay "C" is made of two bell magnets actuating an iron armature carrying a contact point which coacts upon a second point, as seen. Connections for the various parts are shown in drawing "D." Practically any kind of relay can be advantageously used. The transmitter is of the supersensitive type and which can readily be made by following the instructions given in the November, 1915, issue of this journal on page 333 in an article entitled "How to Build a Dictaphone." After these various instruments are made they should be properly arranged as portrayed in Fig. 1 and connected as shown in "D," Fig. 2. The instrument is now ready to be used. The only thing necessary to operate the jaw of the skull is to talk or blow a whistle, which will affect the transmitter and in turn the jaw, thereby causing it to rap very mysteriously.

In conclusion several points may be mentioned which if followed will make the apparatus work and appear much more professional. Firstly, the contact disc had best be geared up to the motor, so that it makes about one revolution to 20 or more of the motor shaft. Again, the skull should be arranged so that it may be picked up from the stand and shown to the audience. At Fig. 3, "E," is indicated how a separable rod joint, X, may be contrived, enabling the operator to remove the skull easily for inspection. An indirect electrical method is the best way in which to actuate the jaw. At Fig. 3, "G," is perceived how the electro-magnet D may influence magnetically an iron disc, X_2, joined to the movable jaw, as usual, by a lever or wire. This

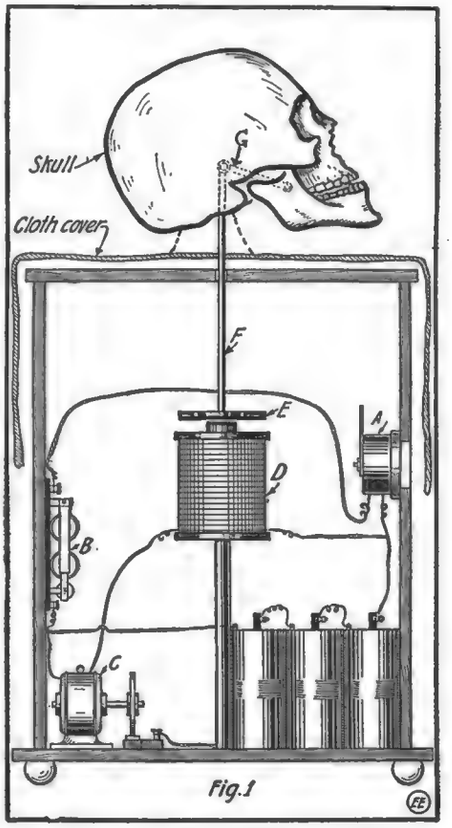


Fig. 1. Assembly Details of Mystic Skull in Cabinet.

permits of minute inspection by the audience. Again, the effect can be attained by placing an aluminum ring in the jaw (properly balancing the jaw to make it work easily) and an alternating current electro-magnet, by induction, will repel the ring (and hence the jaw also) whenever it is energized.

These latter schemes are merely suggestions that may be used to give the apparatus a professional appearance. A final word; it is absolutely necessary to mount the cabinet on a solid support, otherwise vibration will cause it to operate of its own

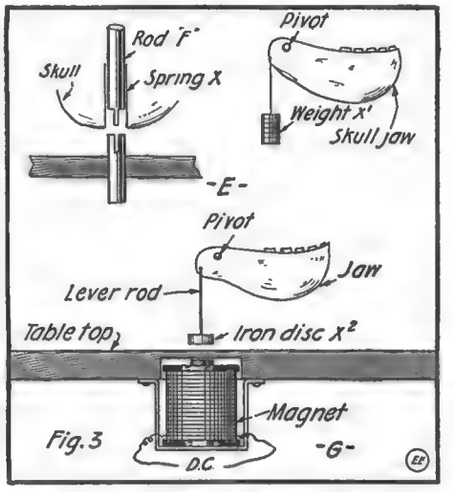


Fig. 3. Details of Jaw Actuating Mechanism.

accord and spoil the whole illusion.

VALUE OF RADIO TO VESSELS IN DISTRESS.

During the fiscal year 1915 the radio inspectors of the United States Navigation Bureau reported 26 cases of vessels leaving our ports which met with accident or disaster, requiring the use of wireless to summon assistance. Four of these were from fire; 12 were from running ashore, stranding, or getting into an ice jam; 3 were from the breakage of machinery; 4 resulted from collisions; 1 from shifting of cargo; 1 vessel was storm-battered and waterlogged; and 1 was torpedoed. Excepting in the case of the "Lusitania," which was torpedoed, the assistance thus rendered resulted in but two lives being lost. Since the close of the fiscal year the following disasters have occurred:

On Sept. 13, 1915, the Fabre Line steamship "Sant' Anna," bound from New York to Naples with 1,700 Italian reservists and crew aboard, caught fire in mid-ocean and all persons on board were saved. The S O S call brought the steamship "Ancona" to the assistance of the disabled vessel and 600 persons were taken off. The "Sant' Anna" then proceeded to port, convoyed by the "Ancona," and the entire 1,700 passengers and crew saved.

Six days after the "Sant' Anna" disaster, the Greek liner "Athinai," bound from New York to Piraeus, caught fire in mid-ocean and was abandoned by the passengers and crew, numbering 470. The call for assistance was answered by the steamships "Tuscania" and "Roumanian Prince"; 341 persons were taken on board the "Tuscania," the remaining 129 being taken off by the "Roumanian Prince." The vessel was entirely destroyed.

The use of radio apparatus on vessels carrying passengers, or with 50 or more crew, is now accepted as essential to the safety of those on board, and the report of the "Athinai" shows conclusively that many persons might have been lost and perhaps the cause of the disaster never known had not this vessel been equipped with radio apparatus.

How to Build a Photophone

Those who are experimenting with selenium will find this manometric flame very useful in their research work. It can be employed in transmitting wireless telephone messages by the use of a light beam acting upon a selenium cell. It can also be successfully employed in recording voice sounds by the addition of a revolving mirror.

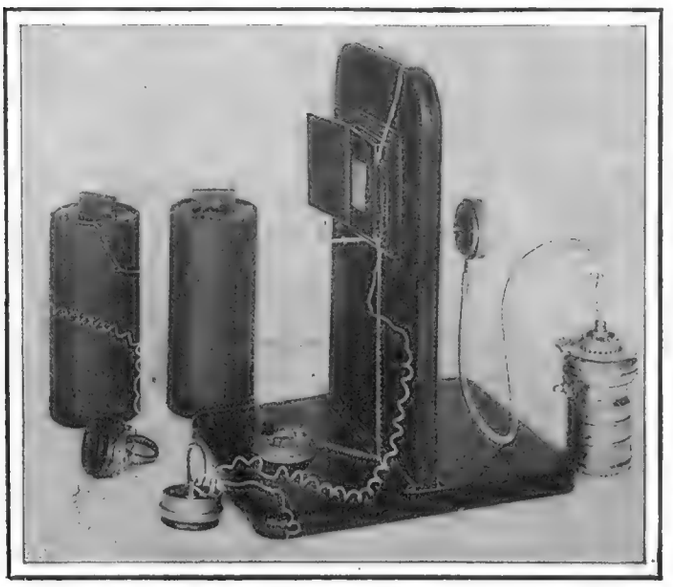


Fig. 1. The Completed Photophone.

The complete apparatus as shown in Fig. 1 was built by William J. Hammer, of New York. A selenium cell is placed behind the flame-tip as perceived and is connected in series with two batteries and 'phones, as photograph shows. In Fig. 2 the constructional details are given. The very first thing to build is the stand, which consists of two strips of well-seasoned wood of either oak or mahogany. It should be made of ¾-inch stock, and the details of same are given in both figures.

The most important apparatus of this outfit is the instrument A, which causes variations in the flame at the tip, and this is made from an old shoe blacking can. The can is first thoroughly cleaned by applying hot water and a rag; after this is done a 1-inch hole is made in the cover, as seen in Fig. 2. This can be made by either drilling or else sawing it out with a jeweler's saw. A ⅝-inch hole is drilled in the center of the back for securing a brass tube B. This tube should be well soldered on the back and is used for transmitting the gas to the tip. Another tube C of the same size is secured on the bottom of the case, and this also should be soldered, and is connected to an acetylene gas generator by means of a rubber tube. The diaphragm is next provided, which consists of goldbeater's or pig's bladder skin of very light quality. First the latter is laid across the case with its cover removed and the skin is then tightly stretched across the edge of the box, and finally the cover is placed over the diaphragm. This is firmly pressed into its proper place. The edge of the cover is next soldered all around the case in order to make it perfectly gas-tight.

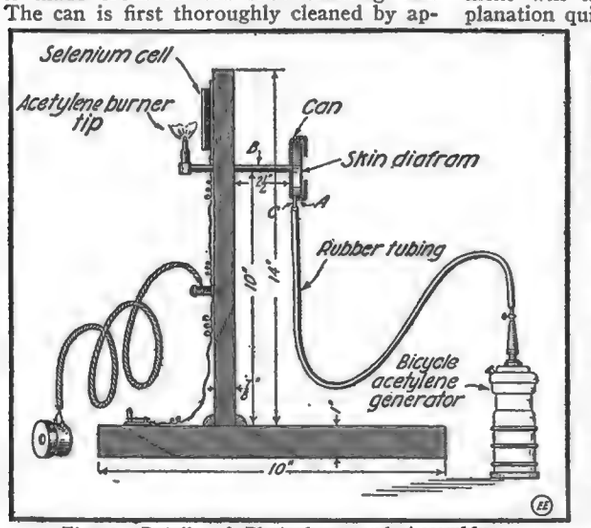


Fig. 2. Details of Photophone and Assembly.

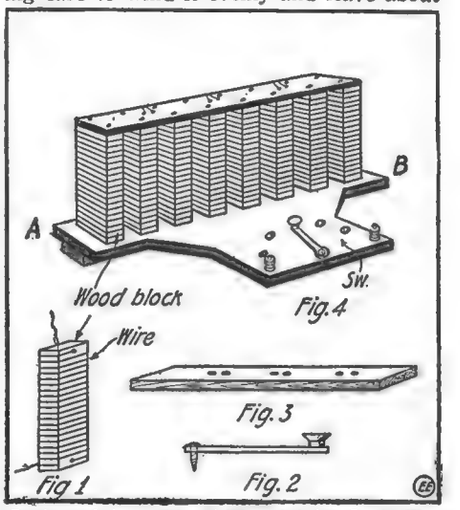
Having finished all this, a hole is made in the upright wooden standard 10 inches from the bottom and 2 inches from the side. The tube B is now carefully inserted through this hole and firmly held in place by applying some sealing wax around the tube. An ordinary acetylene gas tip is procured and placed over the end of the tube as observed.

A small selenium cell is now placed in back of the flame tip. This is held in position by means of two brass strips, which are screwed on to the base by wood screws. Two binding posts are next placed on the upright support and these are connected to the cell, which in turn is connected in series with a telephone receiver and several batteries, as the photograph depicts.

The experimenter who is not familiar with the working principle of this instrument will find the following simple explanation quite satisfactory: At first, when the gas enters the chamber, a straight flame is produced at the tip; but as soon as one begins to talk near the diaphragm at A the volume of gas is interrupted, and consequently the flame is varied in brilliancy, this being directly proportional to the intensity of the sound against the diaphragm. Therefore the change in the voice will be reproduced in the flame, and in consequence will affect the sensitive selenium cell, which then operates the telephone receiver according to the variation of resistance. As this is governed by the gas flame, therefore the voice is accurately duplicated at the receiver by merely talking against the skin diaphragm. Of course, it should be understood that the selenium cell can be placed at any distance from the flame, light will be required. This principle, greatly enlarged upon, as by using an electric arc lamp, has enabled speech to be transmitted for several miles; one record attained by the late Herr Ruhmer having been 14 miles.

RHEOSTAT FOR SMALL MOTORS.

This rheostat is composed of a base-board, eight hardwood blocks and a strip of wood for the top piece, used as a binder. The blocks are ¾ inch thick, 1½ inches wide and 4 inches long. A hole is made through both ends of the block, through which one end of wire is passed. The wire is then wound around the block, taking care to wind it evenly and leave about ⅛ inch between each strand. Put the wire through the opposite hole and clip it off, leaving just enough wire so that connections may easily be made. This step is shown in Fig. 1.

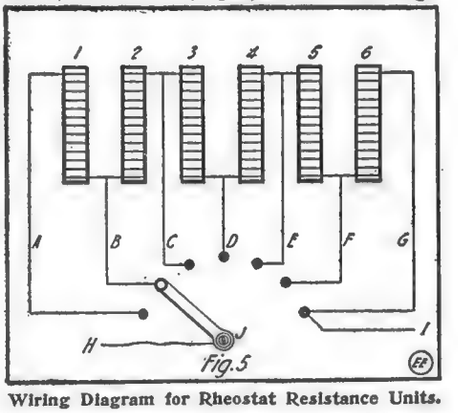


Parts and Assembly of Rheostat for Controlling Small Motors.

When the eight blocks are wound mount them at the rear on the base-board; cut in the design shown in the drawing, the rear measuring 9 inches from A to B in Fig. 4. Screw the strip to each one of these blocks as shown in figure. The switch may be made of suitable metal 3 inches long, ½ inch wide. At one end glue half of a spool as shown in Fig. 2. When completed it should look like Fig. 4.

The connections are made as follows: Coil Nos. 1 and 2 are connected at the bottom, Nos. 2 and 3 are connected at the top, and so on to the end. The leading-in current is connected at pole H, and so on to J, while the leading-out wire is made fast to pole I.

The switch arm is moved over to the first contact point, which starts the current through wire A down through coil 1, up coil 2, down coil 3, up 4, and thus through 6 and out wire G. Should this offer too much resistance, move the switch to contact 2, which sends the current through wire B, up through coil 2, down 3, up 4, etc., and thus out wire G.



Wiring Diagram for Rheostat Resistance Units.

The contact points and binding posts may be made or bought at very low cost.

Contributed by JACK CRANDALL.

HOW TO MAKE IT

This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

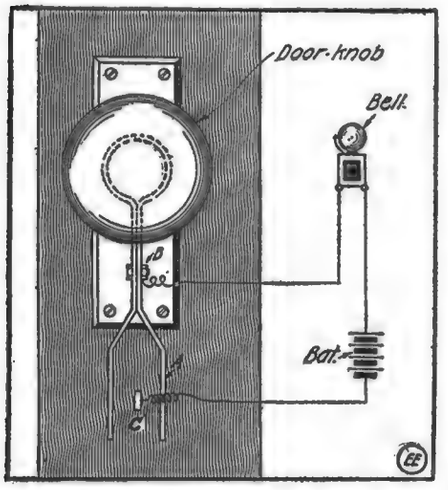
FIRST PRIZE $3.00.

A SIMPLE DOOR BELL ALARM.

An easily made switch for ringing a bell to let me know when anyone opens the door of my shop is here described.

A metal strip (A), preferably of copper, should be bent into a small circle at the middle to fit over the doorknob bar. A small bolt will draw it up tight around this bar at (B). Place between the prongs and fasten to the door a metal strip (C) and the device is complete.

By connecting a battery and bell as shown a slight turn of the knob either way will throw one prong or the other against (C), completing the circuit and ringing the bell.



Electric Call Bell Attachment for Door Knobs.

Contributed by C. REX GILBERT.

METHOD OF THREADING HOLES IN CARBON AND OTHER MATERIALS.

The following is a suggestion for threading holes in pieces of carbon and other material without taps. Bore a hole in the carbon a little deeper and with a larger diameter than the length and diameter of the screw you intend using. Then nick the edge of the hole with a file or saw. Melt sufficient lead to pour into the hole, and while the lead is still in a molten state insert the screw. When the lead has hardened the screw may be removed with a screw-driver.

Contributed by PHIL TAUB.

THE INITIAL STEP.

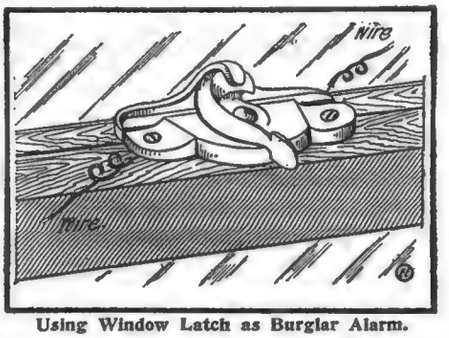
"I hear, old man, that you are going in for wireless. What have you got toward it?"

"A catalog, two binding posts and a buzzer."

SECOND PRIZE $2.00.

USING WINDOW-LATCH AS A SWITCH.

A window-latch can be used as a single-pole, single-throw switch by connecting your wires as shown in the diagram or by



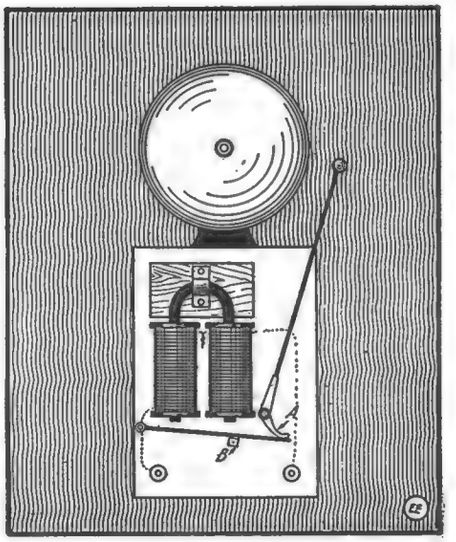
Using Window Latch as Burglar Alarm.

connecting the wires as on an ordinary single-pole, single-throw switch. The latch may be of any metal. This is useful for closed-circuit burglar alarm circuits.

Contributed by BERNARD COHEN.

A SOMEWHAT DIFFERENT ELECTRIC BELL.

The bell herewith illustrated is very simple, but a few words may make its construction clearer. It differs from the ordinary style of bell in that it has a hinged armature instead of a spring one. The clapper holder A is made from a piece of heavy copper. A hole is drilled and tapped



An Electric Bell of Radical Design.

to take an 8-32 brass machine screw. A further hole is then made in the base into which the screw will fit very tightly. Before putting the clapper holder on a brass nut should be put on the screw for convenience in making the connection. In operation the bell works as follows: When a current flows through the magnets the armature is drawn up against the pole pieces which actuate the clapper. When the clapper strikes the bell the arm of A should just barely be clear of the armature, thus breaking the circuit. The armature drops back before the clapper and when the latter drops the circuit is again completed.

Contributed by SELMER WICK.

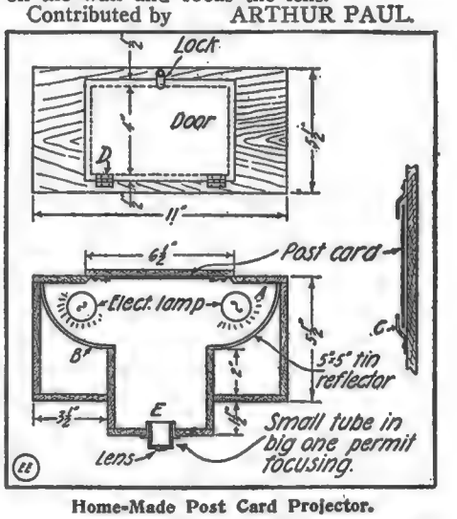
THIRD PRIZE $1.00.

POST CARD PROJECTOR.

The materials required for this device are two electric lamps and two sockets. Also two pieces of tin 5x5 inches, "B"; two strips of tin 1x4 inches, "C," bent as shown; two small hinges, "D"; a lens having about 5 inches focal length, "E," and some pieces of hard wood.

From the hard wood construct a box 11 x5½x5½ inches, as shown in illustrations. Then put the lamps, reflectors, lens, door with post card holder and hinges on same and connect lamps with batteries. To operate put the postal or other picture in holder, close the door and take the machine into a dark room. Then hang a curtain 7x5 feet on the wall and focus the lens.

Contributed by ARTHUR PAUL.



Home-Made Post Card Projector.

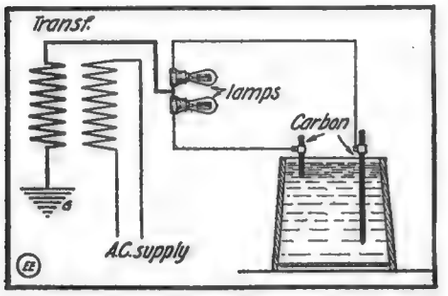
DRY CELLS SHOULD BE DATED.

Dry batteries are useful for many experimental purposes, but have the disadvantage of giving no external indication of being run down. It is a good plan, therefore, to label each cell with the date on which it was put into use. This is especially useful in connection with electric bells, for if a defect occurs one must suspect either the bell, the battery or the wiring. If the battery is seen to have been in service for a long while, it will be advisable to try a new cell rather than spend much time testing the wires or adjusting the bell.

Contributed by H. J. GRAY.

AN ELECTRICAL WATER LEVEL INDICATOR.

A novel form of electrical water level gauge is described by a writer in *Power*. This arrangement is particularly adapted to gauge the depth of water in shallow pans or reservoirs, where, for instance, the total depth is only 5 inches from the overflow outlet to the bottom of the pan. A float of the usual type was tried, but found to be impracticable. As the illustration shows, a 200-watt, 2-coil A. C. transformer was connected with a pair of lamps, which were in turn connected in multiple to the water level in the pan. The terminals in



Unique Water Level Indicating Scheme.

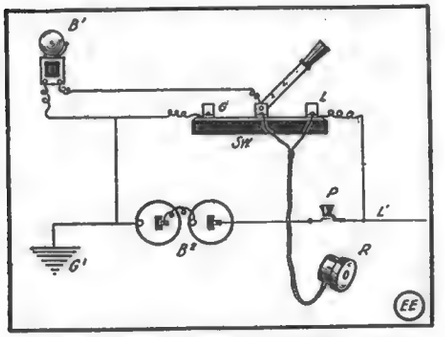
the tank were a pair of arc lamp carbons, one having been adjusted to make contact with the water just before the pan became dry. One side of the transformer was grounded as perceived. One of the lamps was red, while the other was left plain; a red light indicating *overflow*, while a white light denoted *safe water level*. No light indicated *no water* in the tank.

A SHORT DISTANCE TELEPHONE.

Chums can communicate with each other very easily, using the following system, provided the distance between their houses is not much over 200 feet or so.

Connect the following apparatus according to the diagram: B^1, electric bell; Sw. S. P. D. T. switch; R, 75-ohm telephone receiver; B^2, batteries; P, push button; G^1, ground (connected to water pipe); L^1, line or wire running from one house to the other.

Operation: When the phones are not in



A Simple Short Distance Telephone Set.

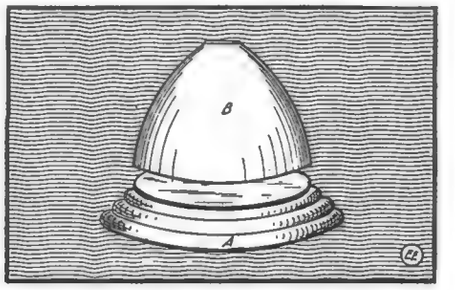
use place the blade of switch on L. Now if you wish to talk to your friend push the button P several times and then throw the blade to G. Your friend, hearing the bell, also throws his blade to G and says, "Hello!" through the receiver R, and you hear the reply in your receiver. (This being used both for transmitter and receiver.)

When the conversation is over the blades of Sw. must be thrown back to L, making the line ready for calling again.

Contributed by JAMES R. HOPKINS.

HOW TO MAKE A PARABOLIC REFLECTOR.

When making up electric bicycle headlights, etc., amateur mechanics are in need



Parabolic Reflector Made from Brass Fixture Canopy.

of a parabolic reflector, which can be made very easily as follows:

Procure from any dealer in electrical supplies a brass fixture canopy of the size required and cut off part "A" as shown in illustration. Part "B" will then serve as the reflector. Then polish the interior and proceed to silver-plate same. A silver-plating fluid can be made by dissolving 1 ounce nitrate of silver in 12 fluid ounces of soft water and adding 2 ounces cyanide of potash. Mix this with enough fine whiting to make it the consistency of thick cream, and with a piece of clean rag or cotton apply same to the polished interior of your reflector. Let it dry and brush off the whiting and you will have a good, silver-plated parabolic reflector.

Contributed by GEO. NIEDERHOFF.

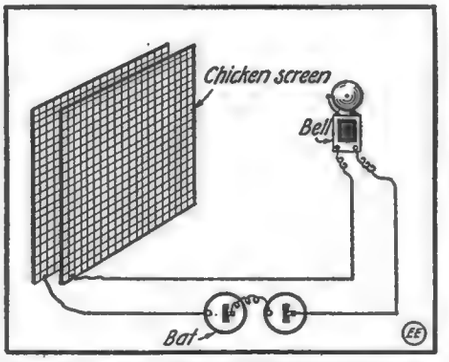
A SAFETY CHICKEN-COOP.

If one has a chicken-coop and is troubled with chicken thieves, he may avoid this by constructing a safety coop.

Take an abundance of wire screen and surround the coop with it. Fasten it to the ground so that it is firm. Then take another screen of the same length and fasten it to the ground so that it is about 1 inch away from the first screen. Take batteries and a bell and connect them with the screens as the diagram shows. Whenever a thief comes to eliminate some of your fowls, he brushes up against the outside screen or leans against it, and thereby closes the circuit, ringing the bell which may be located at any desired place.

Contributed by J. MARCHETTI.

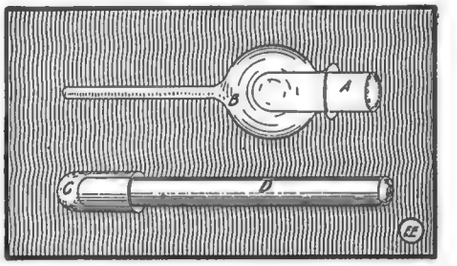
(*The author of the above doesn't state what happens when a strong wind blows or when a "non-burglar" accidentally leans against the fences! Ed.*)



Pressure Against Outer Screen Rings Bell of this Chicken Thief Alarm.

EXCITER FOR CHARGING ELECTROSCOPES.

It is often necessary to test the polarity of an electrostatic charge by means of an electroscope that has been charged with electricity of known sign, either positive or negative. When the charged body which is to be tested is brought near to the instrument the leaves diverge more widely if the sign is the same, or collapse if it is opposite. The usual method of giving the initial charge to the electroscope by induction is inconvenient, because the induced charge is of opposite sign to that of the charging body. By use of the device shown in the illustration either a positive or negative charge may be given direct, and, while strong enough for the purpose, there is no risk of tearing the gold leaves by overcharging.



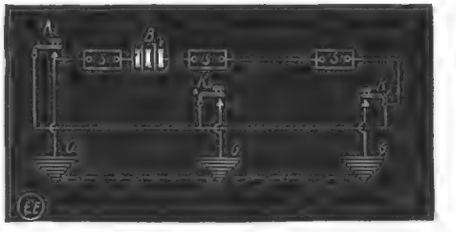
Miniature Static Generator for Exciting Electroscopes.

A thin brass tube A closed at one end is attached to a glass handle B with a little elastic glue or other non-conducting adhesive. A broken "thistle" funnel with the stem cut short and closed in a blowpipe flame makes a capital handle. The open end of the tube must be rounded, or what amounts to the same thing from an electrical point of view, turned in so that the sharp edge is inside. This must be lined with fur, the skin side of the fur being secured to the metal with glue. A smaller metal tube C, similarly rounded at the open end, is secured on the end of a glass rod D, which serves as an insulating handle. Mark the large tube "positive" and the small one "negative." The small tube should be kept inside the larger one when not in use. If quickly withdrawn both become oppositely charged, and either may be used for charging the electroscope or for any other purpose requiring a very weak charge of known sign.

Contributed by H. J. GRAY.

UNIQUE TELEGRAPH SYSTEM.

I thought that it might be of interest to some readers to know that around Spo-



Telegraph System Utilizing Three Sounders and Common Battery.

kane, Wash., some of the farmers use the wire fences for private telephone lines.

The following connections were used by three of us boys on a telegraph line. In the diagram herewith, S.S.S. are sounders, K.K.K. the keys, F.F.F. the ground connections, and B is a battery of either wet or dry cells. The chief advantage of this is that there are no switches, also it is an open circuit system.

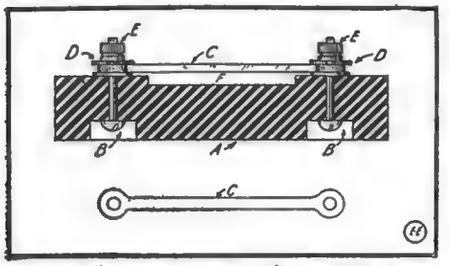
Contributed by JOHN B. MOORE.

Shaking the transmitter will oftentimes improve the enunciation on the telephone.

FUSE FOR BATTERY CIRCUIT.

While a fuse block is not essential for a battery circuit, there is a certain satisfaction in following out the general plan of large power stations, where a properly proportioned fuse is quite indispensable. The illustration shows a simple fuse block that can be made by any experimenter, the fuse itself being quickly renewed when necessary.

The several parts are mounted on a block of wood A that has been well impregnated by soaking it in melted paraffine wax. Two



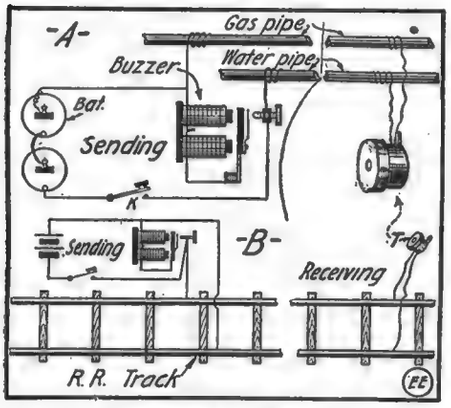
Tinfoil Fuse and Block for Battery Circuits.

bolts B, B, are passed through the underside, the holes being countersunk to accommodate the heads. The bolts may be an inch apart, and serve to hold a strip of tinfoil C, two brass washers shown at D being used to avoid tearing the foil when tightening up the nuts E, E. The strip of foil should be of uniform width, except at the ends, one-eighth inch or less being sufficient for the middle portion. If a small strip of glass F can be cut from an old negative or microscope slide and let into the wood between the bolts it will be an advantage.

Contributed by H. J. GRAY.

BUZZER TELEGRAPHS TWO MILES.

In the October issue of your magazine I noticed in an article where an English experimenter had sent messages over water pipes for one-quarter of a mile. He used a



Telegraphing by Buzzer.

sensitive galvanometer to receive signals with.

My method is cheaper and more efficient. I use a common buzzer and an ordinary 75-ohm telephone receiver. Both gas and water pipes are used, and the danger of a short-circuit by using only water pipes is averted.

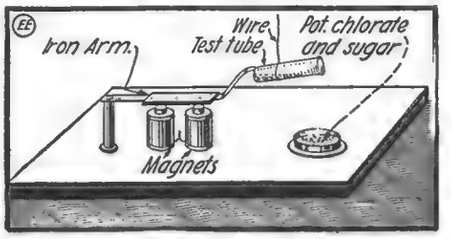
Connect the instruments as at A. The signals come in exactly like wireless buzzes. The farthest distance we ever tried was 1¼ miles, and the signals came in loud and clear.

We also tried this method along the railroad tracks B, and it worked over a distance of two miles.

Contributed by B. SCHUMM.

AN ELECTRIC IGNITER.

This apparatus is intended for the experimenter who does not possess a spark coil with which to ignite fireworks or chemicals at a distance. First wind two small magnets with No. 20 D. C. C. wire



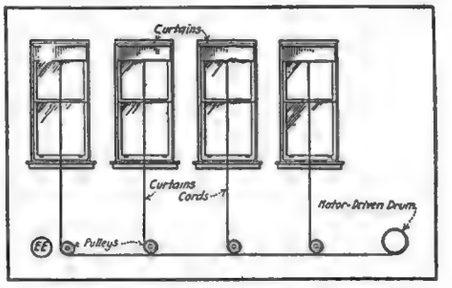
Useful Electric Igniter Subject to Remote Control.

and make an iron armature with a spring brass arm and a clip on the end of the armature. This clip holds the test tube from overturning. When clip is released, gravity upsets the tube which contains a few drops of sulphuric acid. This falls on a mixture of potassium chlorate and sugar. Take equal amounts of sugar and potassium chlorate. This mixture ignites and sets fire to a fuse.

Contributed by ROBERT CHANDLER.

MOTOR RAISES AND LOWERS WINDOW CURTAINS.

A unique device for raising or lowering



Raising Window Shades by Motor.

a number of window curtains has been adopted by a large Western school, says a writer in the *Electrical World*. As perceived, each curtain has a cord secured to same, and these all pass over a series of pulleys down near the floor, and the cords, in turn, pass to the motor-driven drum, as indicated in the illustration. In this way a few turns of the motor will lower or raise the curtains, according to the direction in which the motor is driven. These refinements are not, of course, practical in the ordinary house or hall, but in school or other buildings where there are a large number of windows which are to have their shades repeatedly changed during the day this scheme should find considerable favor.

AN AUTOMATIC "FIRE" ALARM.

This device is very practical for giving an alarm of "fire" in any room or shop. It works on the same principle as the fuse;

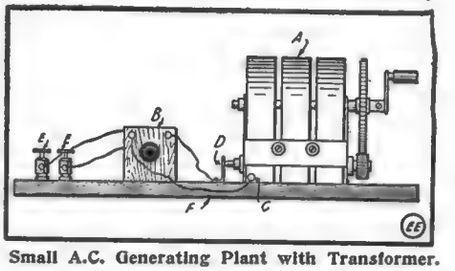
Electric Fire Alarm Using Sealing Wax Fuses.

a bit of sealing wax being used to break the circuit. With very little heat, the wax is melted, the steel spring then snaps down on the conductor terminal, thus completing the circuit and the alarm is sounded.

Contributed by WILLIAM WILLIAMS.

A HANDY A. C. GENERATING SET.

I give herewith brief description of a useful A. C. electric generator which can be made from the parts of an old telephone. Referring to the diagram A is a telephone magneto, B a telephone induction coil to step down the high voltage of the magneto to that of small motors, battery lamps, etc. One of the secondary



Small A.C. Generating Plant with Transformer.

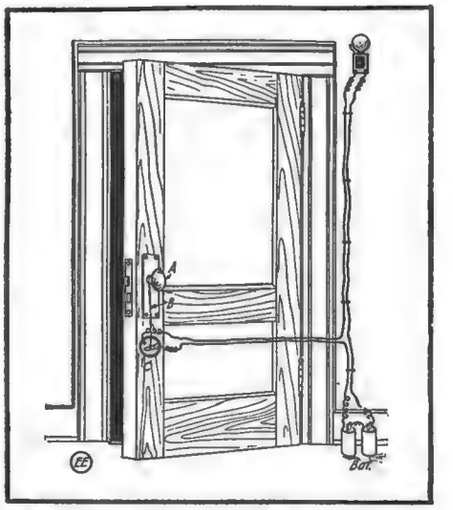
wires of the coil is connected to the contact D, the other to the magneto frame. The primary wires are connected to the binding posts EE. The base is of wood and should be of a suitable size. If the generator is run by a motor small induction coils can be operated nicely.

Contributed by AN EXPERIMENTER.

A SIMPLE BURGLAR ALARM.

This simple burglar alarm can be attached to any door with very little trouble. A string, B, is fastened to the knob, A, by winding it around the knob a few times then tying. The string is then attached to a switch, C, which makes a circuit with the contact when the knob is turned.

Contributed by CARL HANCOCK.



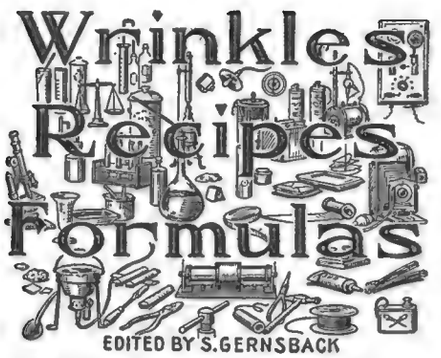
Burglar Alarm Employing String to Connect Doorknob and Switch.

REPAIRING SMALL TUNGSTEN LAMPS.

Don't throw away your burned-out flashlight bulbs. If the bulb itself is not cracked or broken connect it across the secondary of a ¼ or ½ inch spark coil and close the primary circuit for an instant, *not longer*. When you test your lamp on a battery circuit you will find that the two ends of the filament have been welded together and the light is as good as new.

(This does not always work, but it is worth trying.—*Editor.*)

Contributed by C. M. CROUCH.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 19.

Blackings and Polishes for Leather Harnesses, Etc.

1. *Harness Blacking.*—Melt together 2 oz. of *Mutton Suet,* 6 oz. of *Beeswax.* Add 6 oz. of *Sugar Candy,* 2 oz. of *Soft Soap,* 2½ oz. of *Lampblack,* ½ oz. of *Powdered Indigo.* Mix thoroughly and add ¼ pint of oil of turpentine.

2. *Harness Blacking.*—Melt together 4 oz. of *Gelatin,* 3 oz. of *Gum Arabic,* ¾ pint of *Water.* Add when dissolved 7 oz. of *Molasses,* 5 oz. of *Fine Powdered Animal Charcoal.* Heat gently, stirring all the time until the compound is of proper consistency when cold. Must be kept corked.

3. *Polish for Carriage Harness.*—Dissolve 3 sticks of black sealing wax in ½ pint of *Alcohol* and apply with a sponge.

4. *French Blacking to Restore Soiled Harness.*—Take 4½ lb. of *Stearine* in thin sheets. Mix with 6¾ lb. of *Turpentine.* Heat in a water bath, during continual stirring; then add 3 oz. of *Animal Charcoal,* place the whole in another vessel and stir so as to prevent its crystallization. It must be warmed when using and rubbed on with a cloth as quickly as possible, giving it a very thin coat, and when nearly dry polish with a silk cloth.

5. *Waterproof Harness Paste.*—Put into a glazed vessel and melt over a fire 28 oz. of *black resin,* when dissolved add 3 oz. of *Beeswax.* When this is melted remove from the fire and add ½ oz. of fine *Lampblack,* ½ drm. of *Prussian Blue in Powder.* Stir well together and add *Turpentine,* enough to form a thin paste. Allow to cool. Apply with a sponge and polish with a soft brush.

6. *English Ball Blacking for Harness.*—1 oz. of *Lard,* 1 oz. of *Beeswax,* 8 oz. of *Ivory Black,* 8 oz. of *Sugar,* 4 oz. of *Linseed Oil,* 2 oz. of *Water.* Melt the wax and stir in the other ingredients, and when cold roll into balls and use.

7. *Vaseline Harness Composition.*—¾ oz. of *Prussian Blue in Powder,* 4 oz. of *Lampblack,* 2 oz. of *Molasses,* 2 oz. of *Soft Castile Soap.* Warm and mix together in a mortar. Then add 6 oz. of *Vaseline,* 5 oz. of *Ceres,* ½ oz. of *Yellow Resin.* Melt together and add sufficient turpentine to give proper consistency. Mix thoroughly.

8. *Oil for Farm and Team Harness.*—Melt 3 lb. *pure Tallow,* but do not heat it up to a boil; then pour in gradually 1 lb. neatsfoot oil, and stir until the mass is cold. If properly stirred, the two articles will become thoroughly mixed and the grease will be smooth and soft; if not well stirred, the tallow will granulate. Add a little bone black for coloring.

9. *Lacquer for Harness.*—5 parts of *Colophony,* 1 part of *Lampblack,* 2 parts of *Mastic,* 5 parts of *Sandarac,* 20 parts of *Shellac,* 5 parts of *Turpentine,* 100 parts of best *Spirits.*

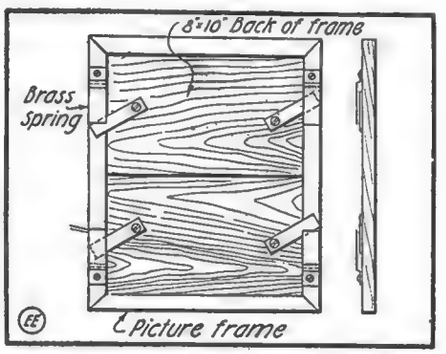
10. *For Russet Leather Harness.*—Mix together 1 part of *Palm Oil,* 3 parts of *Common Soap,* and heat up to 100° F., then add 4 parts of *Oleic Acid* and 1¾ parts of *Tanning Solution* (containing at least 1-16 of *Tannic Acid.*) Stir until cold.

S. G.

EMERGENCY BLUE-PRINTING.

Recently I had occasion to make a blue-print drawing in a hurry, but found I did not have either a frame or the blue-print paper large enough for the work at hand, so the following kinks may come in handy for some readers of your magazine. To make the frame I took down a picture from the wall and removed everything except the glass and frame. I then screwed four pieces of spring copper on it as shown in the drawing. The size of the picture frame was 16x20 and, having two backs for the regular 8x10 photographic frames, I fixed them up as shown. This frame proved to be very serviceable and filled the requirements which were needed.

To make the blue-print paper proceed as follows: Obtain a fairly good grade of drawing paper (Rives or Saxe paper, if it



Making an Emergency Blue-Printing Frame of Large Size.

can be obtained), and cut down to the required size. Next make up a blue-print solution as follows:

Solution A.—Water, 2 ounces; potassium ferricyanide (red prussiate), 120 grains.

Solution B.—Water, 2 ounces; ammonia citrate of iron, 140 grains. (Any proportion of the above can be made.)

When they are thoroughly dissolved, mix and filter, and always keep in a clean bottle. Be careful not to let too much strong light act upon this solution.

The best way to sensitize the paper is to work by an orange light similar to the light used in bromide printing in photography. Float the paper on this solution until it lies perfectly flat. Do not take it out of the solution carelessly, but slide it out by grasping two corners, sliding it over the surface of the water. If it is desired to keep some of the paper for future use this can be done by rolling it up, with the sensitized surface on the inside, and keeping in a tin box free from light.

If any part of the above instructions are not clear I shall be very glad to try and explain anything in doubt upon receipt of a self-addressed envelope.

Contributed by A. WILSDON.

To Remove Oil Stains from Leather.—Cover the spot with *Spirits of Sal-ammoniac;* allow it to act for a short time, cleaning with clear water; repeat until the spot is removed, taking care not to affect the color of the leather.

A GOOD SILVER WASH.

Take 1 ounce of pure nitric acid, 1 silver dime (or, better, a Canadian five-cent piece, which is also silver) and 1 ounce of quicksilver. These ingredients are now placed in a glass vessel and left until they are completely dissolved. Then add a pint of water and next enough powdered whiting to make the whole into a powder. This silver wash may be used on brass, copper, German silver, etc.

CEMENT FOR ATTACHING GLASS TO METAL.

Take about 2 ounces of a thick solution of glue and mix with it 1 ounce of linseed oil varnish and ½ ounce of pure turpentine. This mixture is next boiled in a covered crock and is then ready for use. The articles after being cemented should be clamped together for several days to allow the cement to set properly.

A GOOD SOLDERING SOLUTION.

Procure about 5 cents' worth of muriatic acid and add as much pure zinc as it will dissolve. If a little rain-water is added it will somewhat improve the mixture. The articles to be soldered should be thoroughly cleaned of every trace of dirt. The soldering solution is next applied with a wire brush to the cleaned surface. With this solution the solder will stick every time.

Contributed by WM. A. CAWLEY.

SILVER PLATED PENNIES.

In a solution of mercuric nitrate place a cent so that the coin will be completely covered by the liquid. A chemical reaction immediately takes place; the copper, having a greater affinity for the nitrate than the mercury, forms a copper nitrate, causing the mercury to be deposited on the cent, which gives it a silver-plated appearance.

If mercuric nitrate cannot be bought it can easily be made by dissolving a small globule of mercury in a little concentrated nitric acid, warming, if necessary, to start the reaction.

Contributed by PAUL JENKINS.

HOW TO CUT BRASS AS WELL AS GLASS IS CUT WITH A DIAMOND.

With a quill pen dipped in a strong solution of alcoholic corrosive sublimate (*careful; strong poison*) draw a line on the brass. After letting this dry, go over the line with the pen dipped in nitric acid. Then the metal may be broken as glass is cut with a diamond.

Contributed by JOHN SCHMELZEIS.

MISCELLANEOUS FORMULAS.

A good metal polish may be made as follows: Take wood alcohol, 3 parts; aqua ammonia, 1 part; prepared chalk, ½ part. Apply the polish with a flannel and when dry wipe off. Shake the polish before using to get the chalk stirred up.

Carpet soap can be made as follows: Three small bars of good white soap, 2 gallons of water, 1 10-cent bottle of household ammonia, ½ box of borax and 10 cents' worth of tartar. Dissolve the soap in water on top of stove; then add other ingredients. Let boil 10 minutes and then remove from the stove.

A silver plating for steel can be made as follows: Lunar caustic, 11 parts; sodium hyposulphite, 20 parts; sal ammoniac, 12 parts; whiting, 20 parts, and distilled water, 200 parts, mixed together. Before applying the silver plating to the article clean off all grease.

Contributed by SAUL MARCUS.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

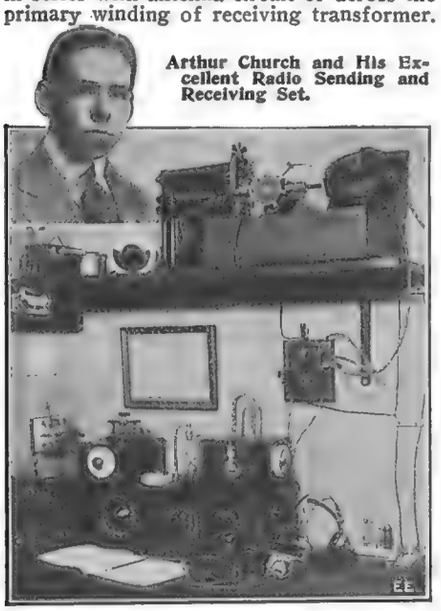
Monthly Prize, $3.00.

This month's prize winner.

ARTHUR CHURCH'S PROGRESSIVE WIRELESS STATION.

I present herewith photograph of my wireless station. The transmitter consists of a 1-K. W. Thordarson transformer and line protector, moulded condenser, rotary spark gap and hinged type oscillation transformer.

The receiving set consists of a special loose coupled tuner of my own design and construction, three variable condensers and fixed condenser, audion detectors and E. I. Co. "Government" type 3,000-ohm receivers. A pair of Brandes superior 'phones are also seen in the photo. A special switch on the left end of the cabinet throws the E. I. Co. .01 M. F. variable condenser either in series with antenna circuit or across the primary winding of receiving transformer.



Arthur Church and His Excellent Radio Sending and Receiving Set.

A Mignon vario-selective coupler is sometimes used with very good results, but is intended especially as a portable receiver in which capacity it is admirable indeed. I am using a multi-audifone equipment, and the received signal strength at this station is simply wonderful. N.A.R. comes in at noon loud enough to be read with 'phones off—a distance of over 1,500 miles. W.H.K. and several other stations are audible at times 40 feet from 'phones. Regular communication is carried on with various stations within 300 miles.

Two aerials are employed; one for 200 meter work and the other for longer wave length. The latter is 300 feet long, stretched from a 100-foot mast to a 60-foot pole at the station. I hold a second grade commercial radio operator's license and my official call is 9.W.U.

ARTHUR B. CHURCH.

Lamoni, Iowa.

LAKE PARK RADIO CLUB.

The accompanying illustration portrays some of the apparatus in use at the main station of the Lake Park Radio Club at Des Moines, Iowa.

Radio Station of the Lake Park Radio Club.

The aerial is of the "L" type and contains four wires. We can receive the following stations easily: Ames, Iowa State Teachers' College, East and West High Schools, and we also hear many near-by amateurs.

The following gentlemen hold office: Roy Smith, president; French Holebrook, vice-president; James R. Allen, treasurer; Kerby Moran, secretary.

LAKE PARK RADIO CLUB,
Per James R. Allen, Sec'y.
Des Moines, Iowa.

RADIO STATION OF CHARLIE BARE.

Herewith are presented illustrations of my wireless set and myself. I am using a one-half kilowatt, closed core transformer at present, with a quenched spark gap of my own make. The detectors are also of my own construction. My switchboard is placed 40 inches from the wall, thereby allowing space behind it for tools and materials necessary for making repairs. The aerial consists of four stranded wires, each 75 feet long and 70 feet high.

Well Arranged Station of Charlie Bare.

I am also carrying a line of wireless supplies in my office and use my station extensively for demonstrating.

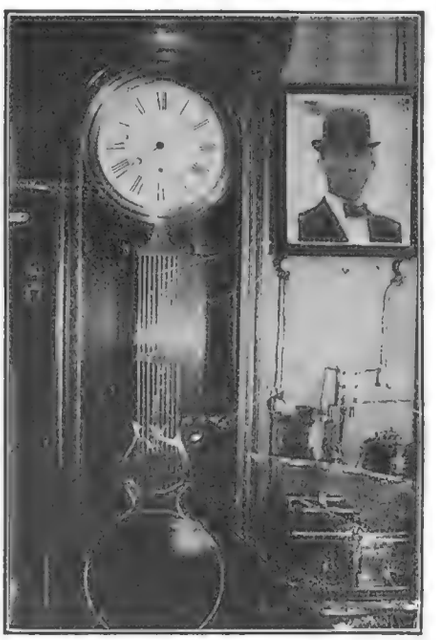
CHARLIE BARE.

Mt. Carmel, Ill.

RADIO TIME SET OF J. B. MACKEY.

About seven months ago, after having read several interesting articles in *The Electrical Experimenter* on wireless and wireless time receiving stations and being a jeweler, I became very much interested in a wireless time receiving station.

Our city gave me permission to attach one end of my aerial to the water tower, which is 110 feet high. This tower being 275 feet from my store gives me an aerial 253 feet between spreaders (I used four wires in aerial). My store is a two-story building, so I only had to erect a 70-foot mast to make it 110 feet at that end. Now comes the interesting feature to the jeweler. On top of this mast that stands 110 feet high over my store I installed a 500-watt Ruby electric light. I made a little attachment that you may notice in the



Wireless Time Station of J. B. Mackey.

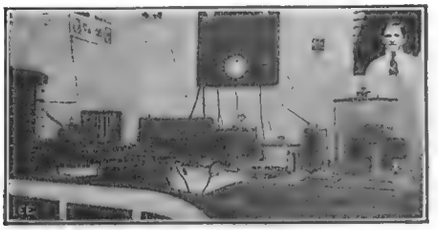
picture, which I attached to the pendulum of my regulator, making a contact every time the pendulum swings back and forth, flashing the time out to the public in perfect synchronism with the time signals given out by Arlington (N. A. A.). The last minute preceding the hour of time the light is made to burn continuous by means of a two-way switch, going out absolutely on the hour. This feature of wireless time has proven a big advertisement for me, and I believe it will for any jeweler. People in a neighboring town about five miles away are able to get correct time regular as it is flashed out. This method of transmitting time has been reported as far as 15 miles from my store. Many people on the streets, when the time is being given, stop and compare their watches to the second.

J. B. MACKEY.

Uniontown, Ala.

WIRELESS STATION OF ROY WUENN.

I am submitting herewith a description and photograph of my set for the Amateur Wireless Station contest. The transmitting set consists of 1½-inch and 2-inch coils, helix, rotary and stationary gaps, two condensers (one a Leyden jar condenser and the other a glass plate type, connected together) and a key. The receiving set has a De Forest rotary variable condenser, Blitzen variable condenser, sliding plate condenser, variometer, tuning coil (800 meters), transformer (3,000 meters), transformer (5,000 meters), two fixed condensers and three detectors, galena, commercial silicon and Radioson detector. The aerial consists of six strands on 12-foot spreaders. It is of the inverted "L" type, 150 feet long, suspended between a 60-foot pole and one on top of the house.



Complete Radio Set of Roy Wuenn.

I purchased some of my instruments from the large wireless station that was at Michigan City. I have received many long-distance station signals, having caught baseball scores sent from New York to Chicago. I shall be glad to communicate with anyone within my range. ROY WUENN.

Michigan City, Ind.

THE IONIZED UPPER AIR.

The theory that the upper layers of the atmosphere are ionized and therefore conduct electricity, first suggested by the late Professor FitzGerald in 1893, has been extensively utilized in recent years to explain the law of decrease of the intensity of radio-telegraphic signals with distance. In an article in the *Revue générale des Sciences* Professor H. Nagaoka, of the University of Tokio, attributes this ionization to two causes. The first is the ultra-violet light of the sun, which he believes is capable of ionizing the atmosphere down to about 40 kilometers from the earth's surface. The second is the stream of electrons emitted by the sun, which, owing to the magnetic fields of the sun and the earth, describe paths far from straight and account for the ionization of the upper atmosphere at night. The greater height of the reflecting layer at night and the consequent reduction in the number of reflections of the waves at the ionized layer and at the earth's surface account for the better transmission of signals at night. The under concave surface of the ionized layer above a station at which the sun is rising focuses the waves from the west near the surface of the earth, and so gives the good signals at dawn. A similar focusing of the waves from the east occurs at sunset. The effect of solar eclipses is explained in the same way, and Professor Nagaoka points out that as the period of an electrical oscillation on the sun is 6.5 seconds, there should be a corresponding period in the stray signals at terrestrial stations. He hopes radio-telegraphic observers will succeed in detecting this period exactly. This opens an interesting field of experiments for the amateur interested in such work.

MAX CLINCH A RADIO ENTHUSIAST.

As I am a regular subscriber to *The Electrical Experimenter* I take this opportunity of tendering photo of my station and myself for entrance in your amateur station contest.

Max Clinch Enjoys His Wireless Outfit Thoroly.

My aerial is of the "L" type, 300 feet long, 65 feet high, composed of four strands of antenium wire, spaced 2½ feet apart.

My receiving set consists of Murdock receiving transformer, variable condenser, crystaloi detector with cohering inductance, fixed condenser and 2,000-ohm Brandes 'phones.

My transmitting outfit includes a New York spark coil, spark gap, condenser, key and 12 batteries.

I have no trouble in getting Key West and can hear Arlington 20 feet from 'phones. I get most of my ideas from *The Electrical Experimenter* and could not afford to be without it.

MAX CLINCH.

Lakewood, N. J.

Amateur News

Radio Experimenter Talks 600 Miles on 1,320 Watts.

F. M. Corlett, wire chief of the Automatic Telephone Co., at his home at 1101 East Eighth street, Oak Cliff, Texas, recently talked by wireless to the Christian Brothers' College in St. Louis. Mr. Corlett has a regulation wireless apparatus erected in his back yard which he has but recently completed.

Mr. Corlett talked to St. Louis, a distance of 600 miles, with 1,320 watts of energy, which is considered unusual. Radio engineers generally figure 10 watts to a mile, which would have given Mr. Corlett a range of only 132 miles.

He picks up the time signals from the station at Arlington, Va., and often "listens in" on pow-wows between the United States transport "Buford" and some Gulf of Mexico neighbor.

Radio Club of America Meeting.

Several interesting papers were delivered at a recent meeting of the Radio Club of America, held at Columbia University, New York City, Mr. Emil Simon, a noted radio engineer, read a paper on Professor Pupin's testimony in a wireless suit between the Marconi and the Telefunken Companies. He expressed his ideas lucidly on the whole subject.

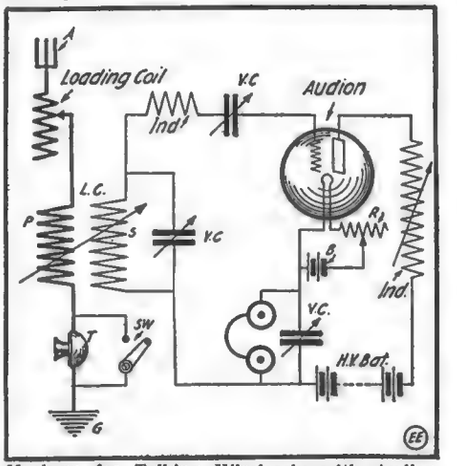
Due to the present patent litigations, no discussion was permitted after the paper was read. Chairman George Elty, one of the engineers who installed the radio telephone apparatus at Arlington, described the system and methods involved in this wonderful radio engineering achievement. He stated that the received wireless telephone message was amplified and then brought back to N. A. A. on a line.

Mr. Sadenwater, radio inspector, described a method and gave a circuit for using a regular audion receiving set as a wireless telephone transmitter and receiver and he proved with this circuit that a distance of over a quarter of a mile can be readily covered, utilizing an ordinary audion bulb. The diagram of the connections is herewith reproduced and it consists of an ordinary Armstrong hook-up, with a telephone transmitter connected in series with the ground lead. It should be understood that the audion must oscillate before it will transmit any current. By placing a short circuiting switch around the transmitter, it is possible to receive messages with the same circuit.

Mr. Whitting, president of the Worcester Radio Club, of Worcester, Mass., described in a very simple manner the exact effects that take place in a complete radio transmitter employing a quenched spark gap.

Among the members who participated in the discussion were Mr. Pacent, vice-president of the club, and Mr. Greeley.

At the December meeting Mr. William Dubilier delivered a paper on the "Construction and Operation" of his well-known direct-current vibrating interrupter.



Hook-up for Talking Wirelessly with Audion.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

University of Pittsburgh Reopens Wireless Plant.

The University of Pittsburgh department of electrical engineering reopened its wireless plant for public communication recently. With the co-operation of the Radio Society of Western Pennsylvania, the wireless work during 1914 and 1915 was satisfactory and a number of interesting experiments were carried on. The plant is similar in design to the immense Government station at Arlington near Washington.

An extensive program is being prepared for the spring. A number of experimental tests are to be arranged with long distance stations. A plan is being arranged whereby many university stations throughout the country will be organized into a radio society.

A large correspondence was carried on with amateurs during the past season and it is expected this service may still be continued. The following program has been inaugurated and will be in force Wednesday and Saturday nights until further notice:

7.30-7.32—General call to all stations, call Q. S. T. signed Pitt; 7.32-7.50—Athletic results; 7.50-8—Items of interest to the public (12 words per minute); 8-8.10—News items at speed of 20 words per minute; 8.10-8.30—Special tests.

Scientific Class Organized in West Hoboken, N. J.

A Scientific Class has been organized in School No. 4, West Hoboken, N. J. Anthony Marino is president. The staff of research workers are John Saldavini, George Matterichi and John Reinert. We would be very pleased to correspond with similar organizations. All mail should be addressed to Anthony Marino, 511 Traphagan St., West Hoboken, N. J.

MEETING OF Y. M. C. A. RADIO CLUB OF VINCENNES, IND.

The Y. M. C. A. Radio Club of Vincennes held its first meeting at the Y. M. C. A., Tuesday, Nov. 30, and was well attended. The club has a very able instructor, who has worked as an operator on the Great Lakes. The following officers were elected: Walter A. Horner, first operator and president; John W. Surbaugh, second operator and secretary; Clinton E. Simpson, third operator and treasurer.

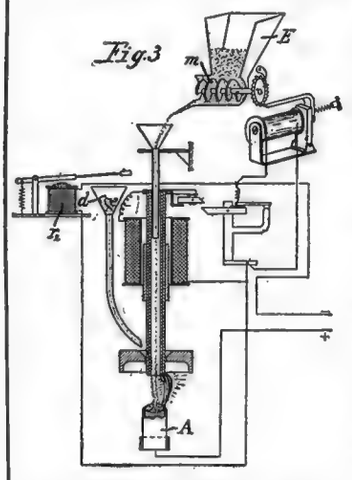
All radio correspondence from radio organizations and interested individuals should be addressed to the secretary, 912 Broadway. Those wishing to confer with the president will find him at 1225 North Second street.

LATEST PATENTS

Novel Electric Arc Lamp.

(No. 1,159,383; issued to Richard Holsten, assignor to Siemens-Schuckertwerke G. M. B. H.)

Electrical arc lamp employing for the lower electrode a suitable cup-shaped chamber A, into which a continuous and properly regulated stream of fine particles such as pure carbon (or any desired mixture of carbon with other substances which emit a strong light, such as metallic salts and the like), are fed. The arrangement is apparent from the illustration. The changing length

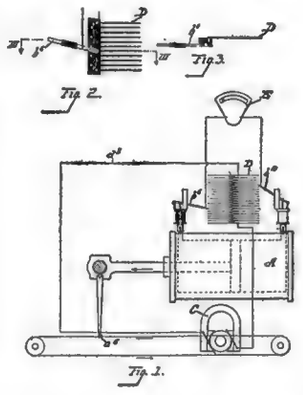


of the arc controls a magnetic clutch which feeds the pulverized carbon from a hopper E through the medium of a worm M. The metal salts may be injected separately through a hopper D, controlled by the magnet R^2. A very interesting patent.

Electrical Horsepower Indicator for Engines.

(No. 1,159,769; issued to Walter H. Hollstein.)

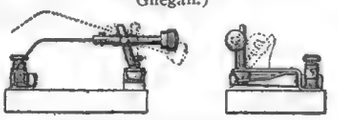
An electrical form of steam engine indicator for ascertaining the horsepower developed is covered in this patent. It appears to be quite feasible and a distinct advantage in this line. As perceived from the illus-



tration the piston rod or cross-head a^2 controls a belt secured to it and also to the shaft of a small dynamo C. The current from this dynamo passes through a resistance D. The changing steam pressures in the cylinder A, actuates the spring controlled rheostat arms b^8 and b^{10} by means of pistons. These rheostat arms slide over contact points as shown in Fig. 2, which lead to the different turns in the resistance coil D. The indications are given on a curve drawing, electric voltmeter E, which may be specially calibrated to indicate results in "horsepower" direct.

Holder for Crystal Detectors.

(No. 1,162,765; issued to John J. Ghegan.)

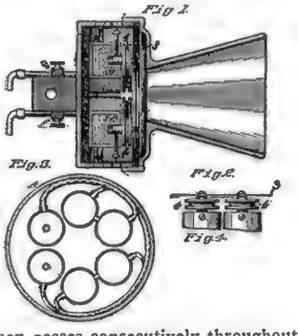


An improvement in wireless mineral detectors giving great ease of adjustment by virtue of the ball joint support of the vertical pillar, carrying the cat-whisker contact. The horizontal arm is also pivoted so as to be adjustable to any position desired. The contact wire can thus be swung up, down, or sidewise, also forward and backward.

Heavy Current Microphone.

(No. 1,165,255; issued to Charles D. Herrold and Emile A. B. Portal.)

A clever design of water cooled, heavy current microphone is here depicted. This patent covers the arrangement for utilizing a multitude of water cooled chambers on the end of each of which there is mounted the usual microphone chamber with carbon grains, etc., 4. These microphone units are all secured to a common metal diaphragm 3. The various water cooling chambers are so piped that water enters into the first one of the group and

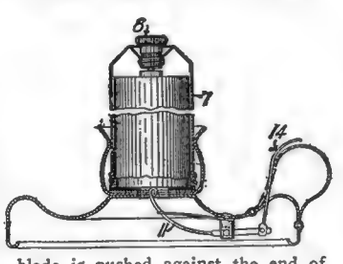


then passes consecutively throughout the entire number before it leaves the transmitter. The design should prove efficient if the size of the diaphragm 3 can be kept down within normal limits.

Portable Electric Lamp.

(No. 1,166,003; issued to Adolph C. Recker, assignor to Waterbury Mfg. Co.)

This patent relates to portable electric lamps, particularly of the candlestick variety. Flashlight battery of the ordinary type fits within a shell or chamber 7. The flashlight bulb is seen at 8, and the circuit from the battery is completed through a switch 11. This switch

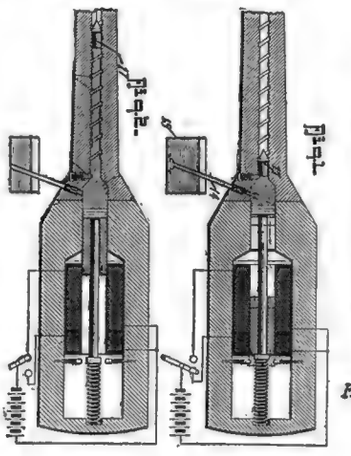


blade is pushed against the end of the battery by a convenient thumb-actuated pin, pivoted in the manner shown. The best feature is that of the control switch.

Electro-Hydraulic Gun.

(No. 1,167,178; issued to Rollie Calvin Hill.)

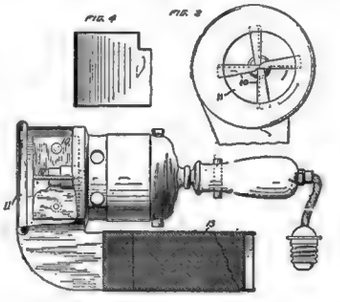
This patent covers the use of water or other fluids in combination with an electro-magnetic propelling mechanism for the ejection of projectiles from a cannon. The patent describes a double solenoid arrangement whereby a switch can be thrown so as to push or pull an iron plunger within the solenoid. When pulled backward, it sucks in the liquid from a tank 15 and when the solenoid is switched to the firing position, the plunger is rapidly propelled forward, simultaneously closing a check valve in the suction pipe 14, and ejecting the projectile 17, by virtue of the sudden rise in the hydrostatic pressure thus obtained.



An Electric Fly-Catcher.

(No. 1,165,712; issued to Frank Rea, assignor of one-half to Arthur M. Sheakley.)

Another electric fly-catcher is here shown which involves the use of a small fan of special design. The metal chamber about the fan is of peculiar shape and terminates in a metal wire cage 13. The apparatus may be plugged into any lamp socket and consumes but little current. In service the flies or other

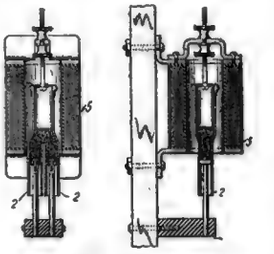


insects are drawn in through the opening 11. The fan blade appears at 10.

Coherer and De-Coherer.

(No. 1,167,163; issued to Crosby Field Frank, assignor to General Electric Co.)

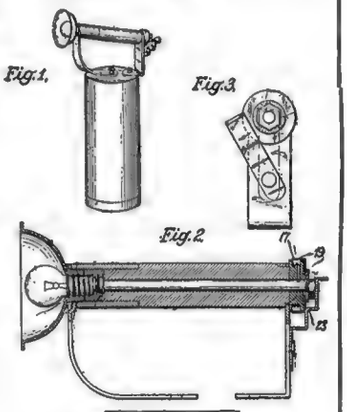
A reliable form of the filings type coherer suitable for transmission line signaling or for other purposes. The patentee mentions the use of granules of nickel specially prepared. The de-cohering is done by means of a magnet coil shown and by the special construction of the coherer tube. The granules, when lifted by the magnet coil 5, will be dropped again unevenly, thus conducing to the regular and reliable resetting of the device. A constant and sharp critical voltage value can be obtained with this improved coherer it is claimed.



Electric Hand Lantern.

(No. 1,163,887; issued to Charles F. Burgess, assignor to C. F. Burgess Laboratories.)

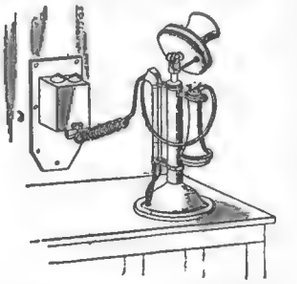
An ingenious electric lantern attachment suitable for use with standard dry cells is here shown. The inventor provides a small rheostat in the end of the handle at 17, to protect the lamp when first used on a fresh cell. 23 is then thrown in contact with the shell 19, leaving the resistance in series with the lamp. As the battery begins to lose its energy, the switch is pushed into a vertical position and the lamp burns direct. This attachment can be adapted for use on two dry cells with a strap around them.



Telephone Cord Guard.

(No. 1,164,563; issued to Oadville Yates, Sr.)

The inventor of this attachment for taking up slack telephone cord to avoid abrasions, provides for the purpose a spiral wire spring with small hooks on each loop of the spiral. The telephone cord is wound around this spiral on the inside of it. When the 'phone is unmoved, the spiral appears as in the illustration, but when the 'phone is



moved, it expands. A guard is also indicated for protecting the cord.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ.

No. 40° 15′ 7″ N E by E. **Patent Applicated Feb. 30, 1916.**

THE ELEGGTRICAL EGG EGGSTRACTOR

Be it a secret to all:

That I, Egg S. Natcher, of Yolkville, in the State of Remorse, have devised certain improvements worthy of notice by egg swipers who desire to eggstract the eggs from a nest without eggciting the eggmakers.

The attached specifications and drawing expose all the inards of the machination and lay bare the devilish details of my method of coercing the feathered bipeds to deliver up their contraband goods without the necessity of declaring a blockade.

Considering the details of this nightmare, at 1 is shown an ediffice known as a hen house, named after the inhabitants who abide or reside therein. The chicken on becoming ambitious mounts corrugated pathway 2 leading to the nest. The weight of her wait on the board compresses bellows 3 and thus pumps air into tank 4 and is there stored. The hen then passes into the boudoir 5, at which point, dear reader, we gently draw the curtain.

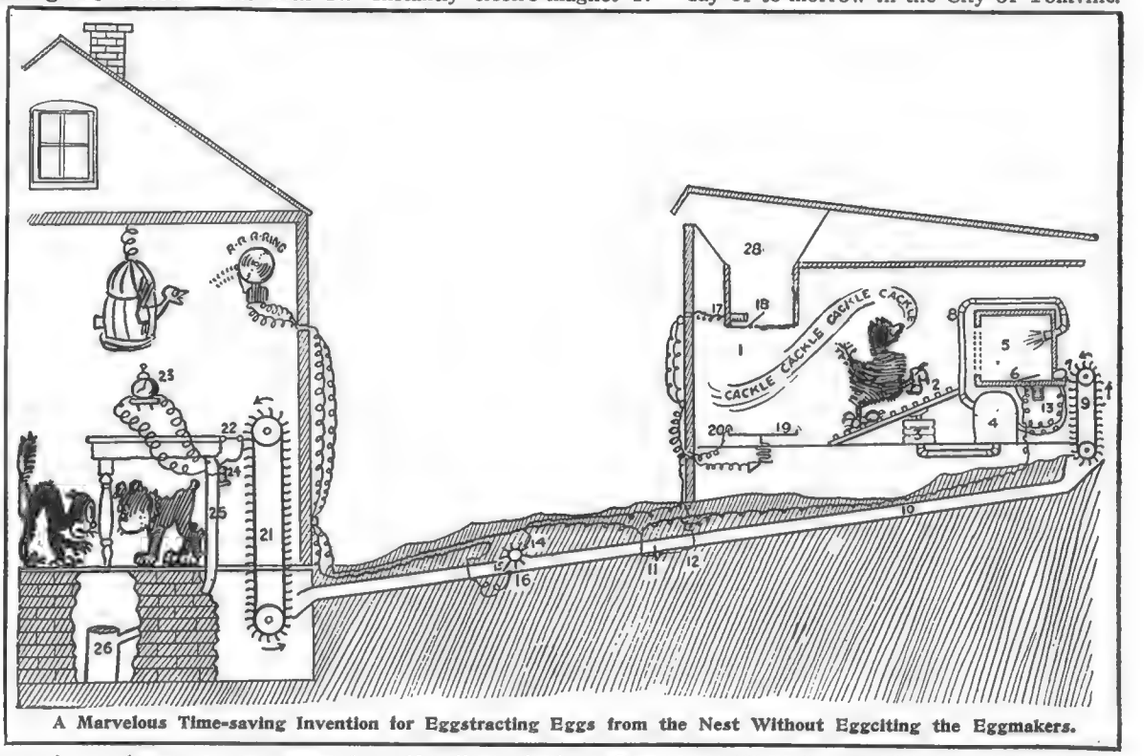
A few minutes and the click of the switch 6 is heard as it is pushed onto contact 7 by the egg. The closing of the switch releases a stream of compressed air from tank 4, which flows through pipe 8 and gently but firmly makes it evident to the hen that her presence is no longer required.

The lonesome and unloved egg rolls then onto conveyor 9 and thence through underground tube 10. With a rising and falling, sinuous motion it approaches switch 11 and without warning swings it onto contact 12 and then continues its explorations. The switch 11 cuts off compressed air supply and resets switch 6 by means of electromagnet 13 and also rings bell in house to warn the reception committee of the approach of their guest of honor.

The egg, then, egglike rolls against the wheel 14 and turns it one notch. On the wheel is arranged a projection that as the wheel completes a revolution makes contact with 16. Instantly electro-magnet 17 acts, opens door 18, allows feed to flow from hopper 28 into pan 19 which, on becoming full, settles gently down on the spring, opens contact 20 and thus hopper door is closed by its own weight.

But to follow the egg. It is rolling along, then suddenly lands on conveyor 21 and gets a raise up, up and over into receiver 22. It rests here awhile from its labors but is quickly awakened by the alarm clock, which closes a circuit, energizes magnet 24, and drops it down through tube 25 into the tomb 26, wherein it is stored. The alarm advises the house of the arrival of the newly born.

In testimony hereto, thereof, I attach my handcuff and seal-packerchief this yesterday of to-morrow in the City of Yolkville.



A Marvelous Time-saving Invention for Eggstracting Eggs from the Nest Without Eggciting the Eggmakers.

(Signed) EGG S. NATCHER,
By his attorney,
Geo. M. Gray,
Needham, Mass.

Witnesses: Sol. Idivory, Hen Nery, R. O. Oster.

THE "ARLINGTON" BUG?

This is an introduction to one of Dame Nature's curiosities and mysteries! X— ??

The other night I was awakened by a shrill —. .— .—, and thought I must have dreamt it; but I heard it twice before going to sleep. The next morning we found a large green winged insect which I suspected of working its "transmitter" on Arlington's call. (N. A. A.)

I would not believe this story myself, if someone else told it, but would like to know if anyone else among the *Electrical Experimenter's* readers has had the same experience.

(*If the "green" bug had an "antenna" it probably was tuned to the tune of "N. A. A.," which caused it to sing when Arlington was sending, what?—Ed.*)

Contributed by

PAUL F. SHNEY.

HEARD OVER THE TELEPHONE?

Pat was called into court to testify to a talk that he had had with the defendant in a civil suit, and everything went along as swimmingly as a flock of bullfrogs until the lawyer attempted to bring out the important points of the conversation.

"Now, then, Pat," said he, encouragingly, "please tell the court what you and the defendant talked about."

"Yis sor," answered Pat, willingly. "We talked about 15 minutes."

"No, no, no!" interposed the lawyer. "I mean what did you and the defendant talk over?"

"Yis, sor," was the calm rejoinder of Pat. "We talked over the tilephone, sor."

THE TUNELESS SOLO.

Signor Marconi, the wireless inventor is likely to prove of great value to his country in the present crisis.

An amusing story is told about a reply that the celebrated inventor once made to a lady who mistook him for his equally famous compatriot, Mascagni, the composer.

"Oh," she said, gushingly, "I'd love to hear you play your beautiful 'Intermezzo!'"

"Madam," replied Marconi gravely, "I'll do it with pleasure if you've got a wireless piano."

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

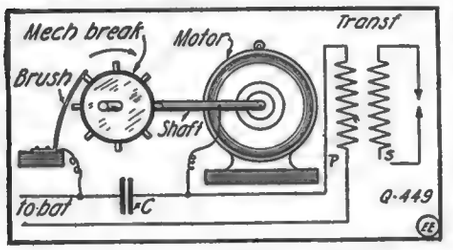
WATCH DEMAGNETIZER.

(448.) William H. Kelly, Holyoke, Mass., wants to know the number of feet of copper wire required to build a 110-volt a.c. watch demagnetizer.

A. About 1,000 feet of No. 30 B. & S. gauge copper wire would be necessary. This should be wound on a brass form or bobbin, having an opening large enough to admit a watch. The length of the spool should be about two inches.

TRANSFORMER.

(449.) C. L. Bauman, Cherokee, Ia., asks whether he can employ a 16-cell bat-



Mechanical Break for Spark Coils.

tery plant of 32 volts and 120 ampere hour capacity to operate his flexible step-up transformer.

A. The transformer can be successfully operated from this plant by employing a suitable interrupter. This interrupter may be of the independent magnetic or mechanical break type. The accompanying illustration gives the connections for the interrupter and transformer.

LOUD SPEAKING RECEIVER.

(450.) Buran Studdard, Leavenworth, Kan., asks us several questions which he would like to have answered. 1. The cost of a telegraphone, as described in the June, 1915, issue of *The Electrical Experimenter*. 2. The price of a loud speaking telephone receiver.

A. 1. The cost of the experimental telegraphone would be in the neighborhood of $75, although this amount would be reduced if built by yourself.

A. 2. A loud speaking telephone receiver would cost $25 of the type to be used in place of an ordinary 75 ohm receiver. A plain independent type loud speaker complete with microphone and rheostat for battery circuits costs about $5.

AUDION BULBS.

(451.) Edward Law, Clarksburg, W. Va., wants to know: 1. Whether a 6-volt 40-ampere hour storage battery will operate an audion as well as six dry cells. 2. The average life of the tantalum filament of the audion bulb. 3. The length of time such a storage battery will last, if used but two hours per day in connection with the audion.

A. 1. The 40-ampere storage battery will successfully operate the audion bulb and, in any case, it will be more satisfactory than the dry cells for this work.

A. 2. The average life of the tantalum filament in the audion is about 400 hours, but this can be lengthened by using the filament at a lower incandescence, i.e., by using a rheostat.

A. 3. Your storage battery will operate the audion bulb for about 40 days if used but two hours each day, without recharging.

WIRELESS BOOKS.

(452.) Fred W. Jameson, Leavenworth, Kan., asks for information on the following: 1. The title of a book on the construction of high grade wireless apparatus. 2. Whether the primary of a loose coupler should be wound with stranded wire, and if the loading coil used in connection with the coupler should be wound with the same size wire. 3. The location of an antenna in regard to a high voltage transmission line.

A. 1. We can recommend two excellent books covering this subject, which are published by The Experimenter Publishing Co. They are "How to Make Wireless Sending Apparatus" and "How to Make Wireless Receiving Apparatus," which are sent prepaid for 25 cents each.

A. 2. The primary of a high grade loose coupler should be wound with stranded wire. While the loading coil may be wound with the same size wire as the loose coupler, it is better to use a larger size wire for this instrument.

A. 3. It would be all right to place a 200-foot aerial directly over and at right angles to the 2,300-volt line. It is also advisable to use means to prevent accidents resultant from having the antenna fall on the transmission line, which would be dangerous in the extreme.

WAVE LENGTH OF COUPLER.

(453.) Leonard Mabbott, Aberdeen, S. D., wishes to know: 1. The wave length of his loose coupler. 2. The reason he can hear a certain station with one hook-up and not with another. 3. The positions of the slider of a loose coupler when it is at its lowest and highest capacity, respectively.

A. 1. The maximum wave length that can be obtained from the loose coupler you describe is 1,800 meters.

A. 2. The reason for your not being able to hear the amateur station you mention with the loose coupler circuit is that the wave length is longer than the transmitting wave from the other station, but this can be remedied by connecting a variable condenser in series with the ground.

A. 3. When the sliders are at the starting end of the winding of a loose coupler, the instrument is being used at its minimum capacity; conversely, when they are at the opposite end of the winding the maximum wave length capacity is reached.

ANTENNA QUERIES.

(454.) George D. Hankins, Yorktown, Ind., 1. Sends us a diagram of his antenna, and wishes to know whether a better type could be designed with the same amount of wire. 2. The efficiency of the loose coupler described in the September, 1915, issue of *The Electrical Experimenter*.

A. 1. A straight four-wire antenna would be more efficient for transmitting than any other form of aerial, but the same amount of wire used in a single line would make a far more efficient antenna for your receiving purposes than most other types.

A. 2. Although this loose coupler with both windings wound with No. 26 wire would be almost as efficient as if wound with No. 24 and No. 28 wire respectively, yet it is advisable to have the windings of different sizes of wire. This depends upon the type of detector employed, i.e., whether potential or current actuated.

PROBLEMS IN ELECTRICAL WORK.

(454A.) Jas. A. Davis, Pittsburgh, Pa., sends us several electrical problems: 1. How many amperes will a 22 h.p. dynamo produce, the output of which is 120 volts? What is the resistance? 2. A relay has four windings of 10, 20, 25 and 80 ohms connected in parallel. What is the resistance of the relay? 3. If .08 amperes flows through a keyboard lamp, what is the difference of potential?

A. 1. This dynamo will produce 136.7 amperes. The resistance is .087 ohms. These results were obtained by multiplying the 22 h.p. by 746 watts and dividing the product by 120 volts, which gives the amperes. The resistance is obtained by substituting the values in the following formula: $R = \frac{E}{I}$

R in ohms, E in volts and I the current in amperes.

A. 2. The answer to this problem is 4.9 ohms. This result was obtained by substituting the values given in this formula:

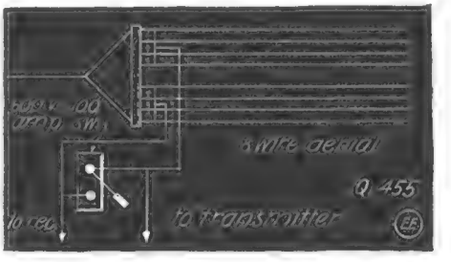
$$R = \frac{1}{\frac{1}{r} + \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}};$$

where r and r_1, etc., stand for the given resistance values.

A. 3. We cannot say what the difference of potential is as you do not state the resistance of the circuit. It is necessary in order to obtain the difference of potential of any circuit to give both the current and resistance.

PUMP USED FOR GROUND.

(455.) Experimenter, Jackson, Mich., wishes to know: 1. Whether a pump could



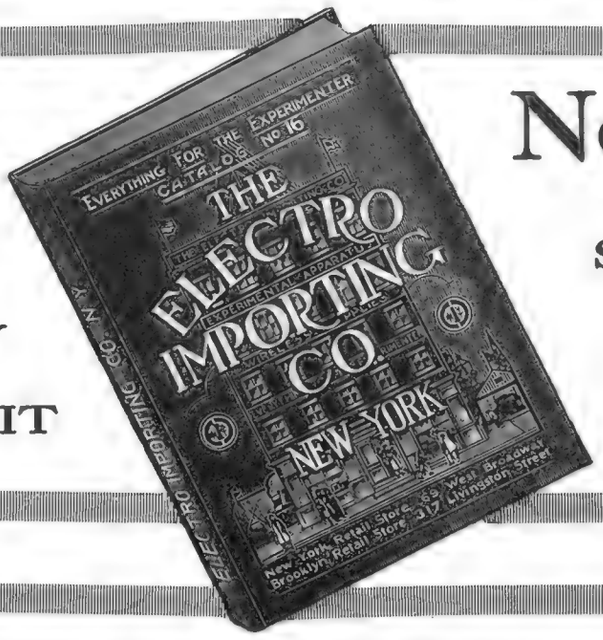
Hook-up for Eight-Wire Aerial, with Change-Over Switch.

be used for a ground. 2. A diagram for an eight-wire aerial constructed in such a

(*Continued on page* 650.)

CAT. No. 16

SEND FOR IT TO-DAY YOU NEED IT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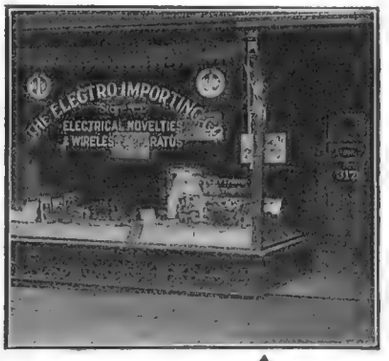

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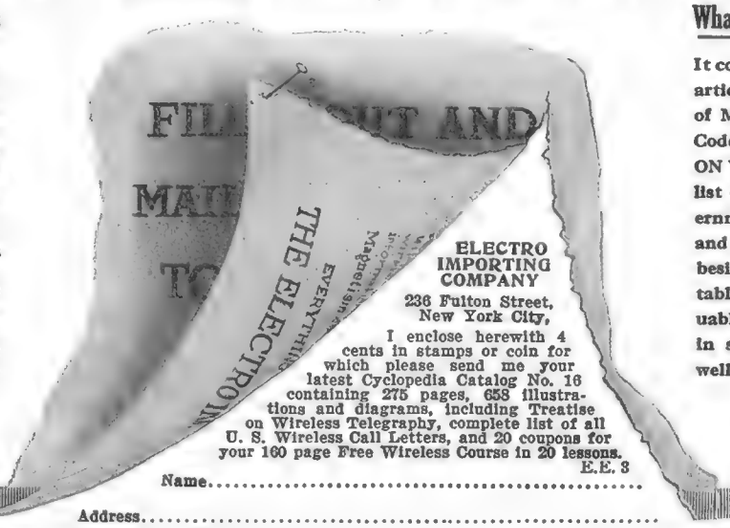

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Electro-Set News

Watch for Our New Catalogue

Published by The Electro-Set Co., Cleveland, O.

MARCH, 1916. 1874 EAST SIXTH STREET

Audion "B" Batteries—50 Volts!!

FOR THE NEW MODEL AUDION DETECTORS

THE ELECTRO-SET COMPANY announce the development of a new, high potential battery for Audion Detectors.

These batteries have been developed for us in the most complete laboratory of its kind in the world.

They are especially designed for long shelf life and voltage maintenance and are a long step forward over the old makeshift flashlight batteries formerly used for the purpose.

Electro-Set Audion "B" batteries will not only increase the efficiency of these splendid wave detectors, but will also prove a considerable saving over the old type, both in initial cost and maintenance.

The open circuit potential of these batteries is about 50 volts; one Electro-Set Audion "B" battery replacing 12 flashlight batteries.

The new model Audion Detectors have been reduced in price and are no longer furnished with batteries of any description.

Our new "B" batteries will, therefore, be a welcome product to the trade.

They are recommended over any other form of battery for the purpose.

Price, each, 50 volts tested and guaranteed.....**$3.50**

Shipping weight 8 lbs.

NOTE: Electro-Set Audion "B" batteries are designed only for Audion use. They are not to be used for any other continuous duty.

Why Buy Minerals on a Gamble?

The least expensive and the *most important* part of your wireless equipment is the mineral in your detector.

An expensive receiving equipment will do only mediocre work if the detector is not sensitive. *Don't Neglect This Important Point.*

READ WHAT OTHERS SAY!

A few letters selected at random from our files.

Milan, Ohio.

The Arlington Tested Galena Crystal that I bought of you some time ago has given the best service, by far, of any crystal I have yet used.

Yours very truly, RALPH H. SAYLES, Jr.

N. Manchester, Ind.

I received your N A A Tested Galena. It is more satisfactory than advertised.

Yours truly, EUGENE SMITH.

Purcell, Okla.

I received the N A A Minerals last week, and I want to tell you that better results have been obtained with them than with any other.

Yours truly, JACK GILLETTE.

It costs mighty little to get extremely sensitive minerals. But it requires caution. Look carefully where you buy. To be *sure* accept only *Electro-Set Wireless Minerals.* Every package marked thus

GENUINE ELECTRO-SET MINERAL

Look for the Signature

J. S. Newman PRES.

THE PRICES ARE HIGHER.

They have to be. Our buyers scour the world for these supremely good minerals—but remember, after all, that even Electro-Set Minerals are not too high priced for the smallest pocketbooks.

ARLINGTON TESTED MINERALS
INDIVIDUALLY PACKED AND TESTED.

N A A Galena, each crystal carefully tested by experts for distant stations. Individually wrapped and packed in wood containers. Postage paid.....25c.

N A A Silicon, individually tested, wrapped and packed. Postage paid.....25c.

N A A Zincite Couple, specially selected, tested and packed. Extremely sensitive. Postage paid.....50c.

ELECTRO-SET ARLINGTON SILICON

Triple "A" Grade Electro-Set Minerals
Packed in convenient one, four and sixteen ounce cartons.

These ultra-sensitive minerals are the only ones you should buy. Look for the original signature on the wrapper.

PRICE LIST OF TRIPLE "A" GRADE MINERALS

	1-oz Can	4-oz Can	16-oz Can
Galena	25c.	60c.	$1.50
Silicon	25c.	75c.	2.50
Bornite	25c.	75c.	2.50
Copper Pyrites	25c.	60c.	1.50
Iron Pyrites	25c.	50c.	1.50
Molybdenite	25c.	70c.	2.00
Carborundum	25c.	60c.	1.50

Zincite, Pure, per ¼ oz. Can, 50c. **Prices are prepaid**

Dry Storage Cells

CAN BE RECHARGED 300 TIMES.

One charge has energy of **seven** dry cells. 400 amperes on short circuit.

These cells are the newest development in the storage battery field.

They may be used in any position, are easy to transport, cannot spill or corrode, and are ideal for experimental work of any description.

Each cell develops two volts in full charge and has a capacity of 20 ampere hours. They are convenient in shape being about of the same dimensions and size as an ordinary dry battery.

The price is so low that any experimenter can afford them. In the long run, they are much less expensive than dry cells and any garage will charge them at very low cost.

If you have 110 volt direct house current, these batteries may be charged by **merely connecting them in series with 1-100 watt lamp** or 4-25 watt lamps in multiple

USES:

Audion detectors (filament batteries).
Portable and Stationary Wireless Sets.
Automobile Lighting.
Experimental Work.
Hand Lanterns.
Stationary Engine Ignition.

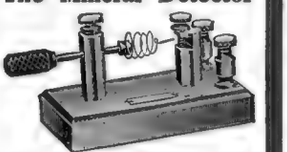
In fact, these batteries may be used in place of any other type of storage cell.

Allow 1 cell for every 2 volts required (i.e., for 6 volts use 3 cells, etc.) Shipping weight 5 lbs.

Price, each.....$2.00

SEND FOR CIRCULAR.

The Mineral Detector



We have greatly improved our popular No. 1603 Detector with no increase in price.

This type mineral detector is the most convenient and easily adjusted ever produced.

In connection with our famous super sensitive minerals, it is as sensitive a detector as you could desire.

Handsome in appearance and generous in size.

The cat whisker wire is easily removed, and replaced in the **Special Chuck Holder.**

Minerals are readily inserted and are firmly held in good contact. Any degree of pressure may be brought to bear on the mineral.

Price, postage paid.....**$1.25**

Dept. 510 The Electro-set Co. 1874 E. 6th St. Cleveland, O.

SEND 4c. IN STAMPS FOR CATALOGUE

QUESTION BOX.

(*Continued from page 648.*)

manner that four wires may be used for transmitting and the whole number for receiving.

A. 1. The pump can be successfully employed for a ground.

A. 2. The diagram herewith shown gives the constructional details of an eight-wire aerial to be used in the manner you specify.

ANTENNA EFFECTS.

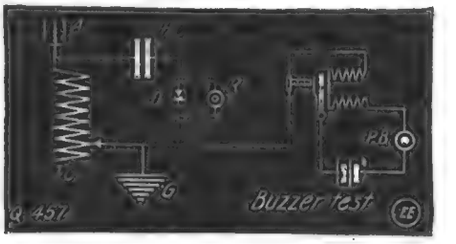
(456.) John Bedford, Morsemere, N. J., desires to know: 1. Whether a 110-volt a.c. line would affect the reception of messages through an antenna placed four feet distant. 2. Whether a ½ k.w. transformer would transmit 40 miles.

A. 1. The 110-volt a.c. line would affect your receiving antenna if they are parallel to each other. You could eliminate this trouble by changing the position of your aerial so as to be at right angles to the a.c. line. Another way of eliminating this trouble would be to erect a second antenna of a larger size at right angles to the 110-volt line and ground same. This will absorb the effects from the a.c. line and thus the smaller antenna will be freed from the disturbance.

A. 2. A ½-k.w. transformer can readily transmit 40 miles, and would generally have a longer range if properly connected and tuned.

RADIO HOOK-UPS.

(457.) Sidney Rosenthal, Brooklyn, N. Y., 1. Wishes us to give him the hook-up for a receiving set comprising a tuning coil, fixed condenser, galena detector, buzzer



Simple Wireless Receptor-Circuit With Tuning Coil.

test and receivers. 2. Also if two persons can operate separate receiving sets from the same aerial.

A. 1 The illustration herewith shows the connections for the instruments you mention.

A. 2. It is possible for two receiving sets to be operated from the same aerial, but the energy received in either one set would be considerably reduced, unless the wave lengths utilized are quite different in value.

ROTARY GAP.

(458.) Rudolph Wensko, Cleveland, O., inquires: 1. Whether a rotary gap will work on a ½-k.w. transformer coil. 2. At what speed must an amateur be able to send and receive signals in order to obtain an amateur license. 3. The manner in which the taps of a Navy loose coupler are connected, so that one turn at a time may be obtained.

A. 1. A rotary gap can be successfully operated on a ½-k.w. transformer coil, but a quenched gap is best.

A. 2. An amateur must be able to receive and send at least 10 words per minute to obtain a government radio license. He must also be familiar with the technical

details of radio apparatus to a fair extent.

A. 3. A description of the Navy type loose coupler was published in the September, 1915, issue of *The Electrical Experimenter*, which included the method of connecting the taps so as to obtain single turns at a time.

RADIO TELEPHONE.

(459.) Edward C. Jones, Jr., Fairmont, W. Va., wishes information as to: 1. Whether there is an inexpensive wireless telephone set available that can transmit three miles. 2. If it is possible to construct a wireless telephone with a 1-inch spark coil, microphone, etc., and obtain good results. 3. Whether a dictaphone, of the type described in a recent issue of *The Electrical Experimenter* could be used as an amplifier.

A. 1. As far as we know there is no cheap wireless telephone for the use of the amateur on the market, but we would suggest that by writing the Radio Telephone and Telegraph Company, of New York City, you would no doubt be able to find out if any such telephone is for sale at a price within your reach.

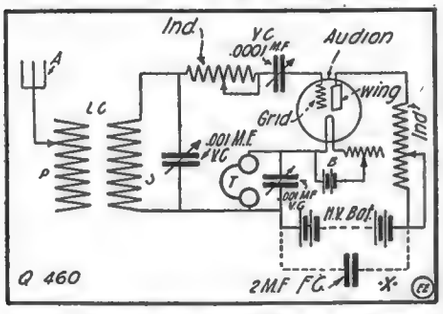
A. 2. It is possible to construct a simple wireless telephone outfit by employing a 1-inch spark coil, microphone, etc., but the results would be very poor on account of the unequal sparking rate of the gap which gives irregular sounds at the receiving end, and also due to the low frequency of the sparks. Although the results may be bettered by using several spark coils connected in parallel so as to form a multiple sparking gap, which will increase the sparking rate of the complete device of course. Even then the speech at the receiving end will not be clear. This outfit will transmit over a short distance of, say, about a mile or more. A very short spark gap must be used, about the thickness of the paper of this page.

DIAGRAM FOR UNDAMPED WAVE RECEIVER.

(460.) Reginald Pink, Bronx, N. Y., wishes us to give him the following information: 1. A diagram of an undamped wave receiver employing the audion. 2. The size of wire employed in winding the various coils. 3. Whether the Electro Importing Co.'s Mignon Vario-Selective coupler will receive undamped waves with an audion.

A. 1. The accompanying illustration gives the proper hook-up for the reception of undamped waves, employing the audion. The capacities of the various condensers are given. Condenser X is optional but is strongly recommended.

A. 2. The secondary loading coil is wound with No. 28 B. & S. copper magnet



Audion Circuit for Reception of Undamped Waves.

wire on a tube 4 inches diameter, 30 inches long; while the winding of the "wing" coil is of No. 30 B. & S. copper magnet wire wound on a similar size tube.

A. 3. The coupler you mention may be successfully employed for the reception of

Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

We Guarantee Everything We Make! We Guarantee Everything We Say!

Every County Attorney should have one of our Detectorphones if he wants to know what offenders are plotting.

Every Hotel should have some rooms equipped with our Detectorphones in order that they may detect and eject objectionable characters.

Every Business Man should have one of our Detectorphones if he wants to know which of his employees is planning and plotting to bring on a strike.

Every Detective should have one of our Detectorphones if he wants to succeed, for you can tell just what the fellow you are after is saying even in the faintest whisper, forty feet away, in the garret or in the cellar.

Price, $35.00.

UN-DAMPED-WAVER.

Do you want to get Nauen, Hanover, Sayville, Tuckerton, San Francisco, Honolulu and the Naval Arc Stations on just a good, ordinary Aerial? Do you want to become thoroughly familiar with the action of the new valve circuits? Then you want our Un-Damped-Waver.

Price, $100.00.

TWO STEP MULTI-AUDI-FONE.

Are you a jeweler? Do you want Arlington time shouted to your visitors every day at 12? Are you a teacher of wireless? Do you want your 500 students to read the signals? Both of you men should have our Two Step Multi-Audi-Fone with its Trumpet Horn with specially wound Head Set.

Price, $75.00.

MULTI-AUDI-FONE.

Do you want to get a lot of stations you do not hear now? Do you want to get those you now hear only faintly and unsatisfactorily, clear and strong, often even audibly? Do you want to enter a new Wireless World? Then you want our Multi-Audi-Fone.

Price, $30.00.

TELEPHONE VOICE MULTIPLIER.

Are you hard of hearing? Are your Telephone lines or connections poor? Are your long-distance calls weak? Do you want to know exactly what the fellow at the other end of the line is saying? Then you want our Telephone Voice Multiplier.

Price, $15.00.

Everyone of these instruments is *one hundred fold better than any other instrument of its kind.*

If you don't believe it—try them.

If after a ten days' trial you are not surprised and more than satisfied—we will return your money.

Will any one else do this? Tear this out and ask for information about the instrument that interests you by writing its name here

Send for circular to-day
Ask your dealer to-morrow

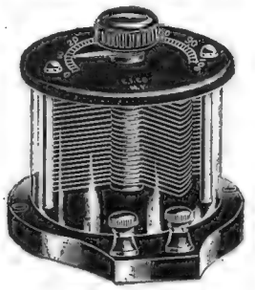
MULTI-AUDI-FONE

273 Morris Ave.
ELIZABETH, N. J.

Chicago Wireless Headquarters

CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.

ROTARY VARIABLE CONDENSERS



Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75

No. 10. TUNGSTEN FLASHLIGHT 6 inches long, complete .....65c. Extra battery....20c. Extra bulb....15c.

60 and 100 Watt Nitrogen Lamps use less current; give white light. 60 Watt.....85c. 100 Watt.....90c.

No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....45c. Extra bulb, 15c. Extra battery, 20c.

FINE 50c. POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (3 for 25c.), or each 15c. New Flints, 5c. 6 for 25c.

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

LA SALLE LIGHT COMPANY, 134-136 N. La Salle St., Chicago, Ill., Opposite City Hall

NEW WIRELESS WONDER

THE INSTANT RADIOGRAPH

Greatest invention of the Age. The result of years of experimentation.

Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages

Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

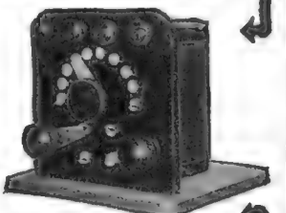
You Can Receive Instantly Without Any Adjusting

3,000 miles is latest record of the Instant Radiograph.

It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.

Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

INTRODUCTORY PRICE FOR MARCH $3.00



Cut ¼ Actual Size.

The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.

The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and 4¼ inches high; binding posts are made of non-corroding metal, heavily silver plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be proud to have in your wireless station.**

The Radiograph is the greatest recent invention in the Wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalog E of the Instant Radiograph.**

You need this new book. "Radio Stations of the World." A complete authentic list of call-signals of every public wireless station. Price, only 50c.

UNIVERSAL WIRELESS COMPANY, 19 East 32nd St., New York

This New Tuner Only $8.00

"Your New Receiving Transformer having 20 taps on the primary and 9 on the secondary is very efficient, and worth twice as much as the one with sliders, although that tuner does great work. Gordon F. Danforth, Syracuse, N. Y."

We also make a 10,000 meter tuner
Send 2-cent Stamp for Bulletin 107,
Just Out

Colby's Telegraph School
Auburn, N. Y.

undamped waves with an audion, with the addition of the inductances just described.

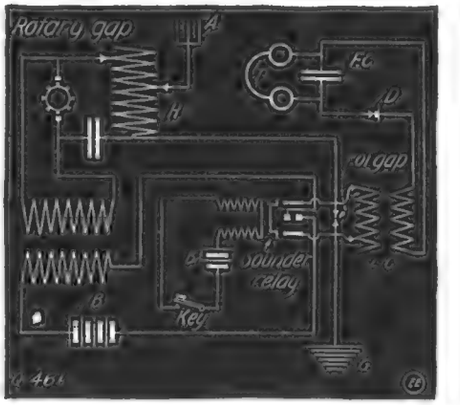
BREAK-IN SYSTEM.

(461.) Elmer C. Lundy, San José, Cal., asks: 1. The length of time for which an amateur license is issued. 2. What device will eliminate the flickering of the lights when operating a transformer on 110 volts a.c. 3. The connections for a satisfactory break-in system, using a rotary spark gap.

A. 1. An amateur operator's license is issued to cover a period of two years, while a station license is given for one year only. These licenses may be renewed by applying to the chief radio inspector of your district, sending him affidavits to the effect that the applicant's station has been in operation for the preceding six months.

A. 2. A kick-back preventer will sometimes help to eliminate the severe flickering of lights caused by the operation of a transformer on 110-volt a.c. lines, but a choke coil is invariably required in series with primary circuit.

A. 3. The illustration herewith shows



Break-in Hook-up for Radio Sending and Receiving Circuits.

the connections of a break-in system, including a rotary spark gap in the transmitter.

KITE AERIALS.

(462.) Ira Hull, Zenith, Kan., wishes advice: 1. As to the size of wire suitable for an aerial that is to be supported by a Malay kite. 2. The number of feet of wire which said kite can support. 3. The wave length that can be tuned with such an antenna, one loose coupler and one loading coil.

A. 1. No. 22 B. & S. bare copper wire can be used with success for the aerial supported by a Malay kite.

A. 2. The kite will be able to carry about 1,000 feet, although this length could be increased by using finer wire.

A. 3. The wave length to which you could tune with this outfit would be about 8,000 meters.

REGARDING WAVE LENGTHS.

(463.) Henry Gerke, Westwood, N. J., wants to know: 1. The wave length of W. C. C. 2. The wave length and the time at which W. H. B. sends "press." 3. Where he can obtain copies of (a) United States Naval Radio Regulations. (b) Regulations Governing Radio Communication. Act of Aug. 13, 1912. (c) Berlin International Radiotelegraphic Convention and Regulations.

A. 1. The wave length on which W. C. C. operates varies from 12,000 to 15,000 meters.

A. 2. The time at which W. H. B. usually sends "press" is 10.15 p.m., and the wave length on which he operates is 600 meters.

A. 3. The copies of these books can be obtained from the United States Printing Office, Washington, D. C.

TELEGRAPHONE TALKING HEAD.

(464.) Radio Amateur, Irvington-on-Hudson, N. Y., wishes us to tell him: 1. Can the armature of a telephone magneto be used in the construction of a telegraphone, if a hole is bored lengthwise through the center of it. 2. Is a pair of 1,000 ohm receivers more sensitive than a single receiver wound up 2,000 ohms.

A. 1. We do not believe that the armature of a telephone magneto can be used in the construction of a telegraphone head.

A. 2. A pair of 1,000 ohm receivers are more sensitive than a single receiver wound to 2,000 ohms. This is due to the fact that the two phones act on both ears simultaneously.

CHEMICALS.

(465.) K. Beymer, Dayton, O., wishes us to give him the name of a house where he may obtain chemical apparatus and chemicals.

A. Eimer & Amend at 211 Third avenue, New York City, should be able to supply your wants for chemical apparatus and chemicals. We would suggest that you write to them for prices and catalog. Also refer to our advertising columns.

SPECIAL ELECTRIC BULBS.

(466.) J. H. Kahler, Rochester, Minn., wants to know: 1. Where he can obtain special electric light bulbs. 2. Where he can have special mercury vapor arcs made. 3. Whether a variable condenser is better than a fixed type when it is used in shunt with wireless 'phones.

A. 1. For these bulbs we would refer you to General Electric Lamp Works, Harrison, N. J., who will doubtless be able to make them for you.

A. 2. These lamps could be built by the firm mentioned in Answer 1, or by the Cooper-Hewitt Electric Co., Hoboken, N. J. The latter company would probably be better able to do this work, as they make a specialty of manufacturing mercury vapor lamps.

A. 3. It would be far more advisable for you to connect a variable or adjustable condenser in shunt with the receivers than a fixed one.

TOOLS.

(467.) Godfrey S. Bloch, New York City, wishes to know what we consider the 12 most important hand tools used by a machinist.

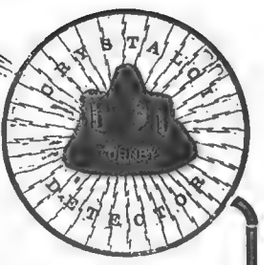
A. The 12 most important tools used every day by machinists and electricians are as follows: Hammer, screw-driver, pliers, hack saw, hand drill, dividers, calipers, chisel, wrench, drill, blow-torch and vise.

INDUCTION MOTOR.

(468.) Ervin R. Musgrove, Longmont, Colo., asks several questions relative to induction motors: 1. About a motor to be operated on a.c. and having an armature composed of copper bars and laminated iron discs, but not fitted with any commutator or slip rings. 2. On the constructional details of such a motor. 3. The reason why different results are obtained when applying Ohm's law to a.c. circuits as compared to d.c.

A. 1. The motor you are interested in falls into the category of induction machines. No commutator or slip rings for conveying current from the outside or feed circuit to the armature winding are necessary as the armature or "rotor," as it is called, has currents induced in its short-circuited windings from the magnetized

5000 miles—
From Hawaii to
Richmond, Va.—
with
CRYSTALOI



"On Dec. 23 I made what I believe to be a new record for the Crystaloi Detector. About 11 P. M. I heard the station at Lahaina, Hawaiian Islands, a distance of 5,000 miles. Heard the station four different times.
(Signed) RALPH J. ROBEY, 3314 Floyd Ave., Richmond, Va."

We Guarantee Every Claim Made for
CRYSTALOI
The Highly Sensitive, Permanent
WIRELESS DETECTOR

What It Is

Crystaloi offers a large surface of highly sensitive mineral, which is brought into contact with a finely divided alloy—thus giving innumerable contact points. By rotating the cylinder the most sensitive spot is found immediately.

What It Does

Crystaloi will work under the heaviest static conditions—will not burn out—and with proper use will last a lifetime. With it every message will come in strong and clear.

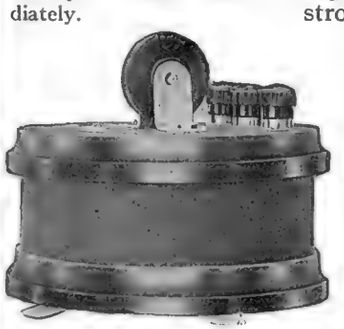
3 TYPES

Crystaloi.

TYPE O—Dimensions 2¼" x 1⅞".
Price, $3.50. Postage 10c

TYPE AA—Equipped with a cohering inductance—Dimensions 4" x 3½".
Price, $6.00. Mail. Wght. 2 lbs.

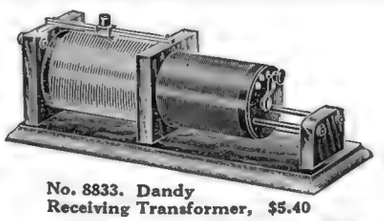
TYPE BB—Equipped with cohering inductance, fixed condenser, buzzer, test, batteries and control. Dimensions 7½" x5½" x 3½".
Price, $12.00. Mail. Wght. 4 lbs.



TYPE AA. SUPER-SENSITIVE

Send 5c. in stamps for Catalog "C" fully describing Crystaloi and all of our other High Class Receiving Apparatus.

Eugene T. Turney Co.
INCORPORATED
2595 Third Avenue
New York City

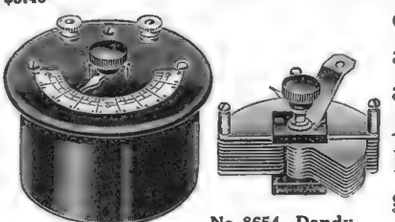


No. 8833. Dandy Receiving Transformer, $5.40

Are *You* looking for *Quality—Design* and *Workmanship* consistent with price?

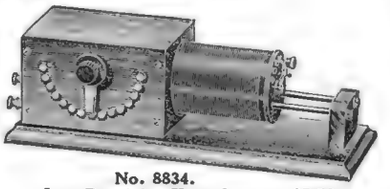
If you are, then get our catalog No. 36E. Illustrating and describing about **300** articles of Amateur-Radio Telegraph apparatus.

We also Manufacture
Telegraph and Fire Alarm Apparatus, Dry Batteries, Medical Batteries, Bells, Line Equipment, Novelties, Etc.



No. 8654. Dandy Rotary Variable Condenser, $3.30

J. H. Bunnell & Co., Inc.
32 Park Place
Broadway Block NEW YORK



No. 8834. Jove Receiving Transformer, $7.50

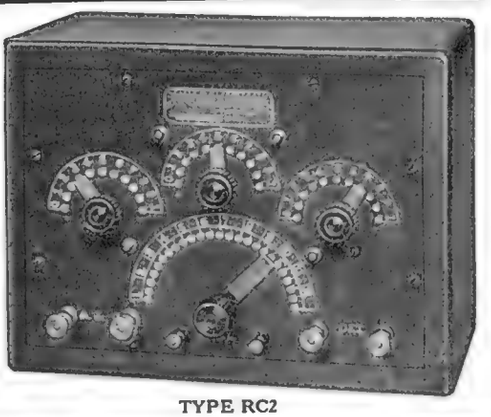
SUPERIOR MIGNON SYSTEM RADIO APPARATUS

"Mignon System"

Apparatus of Scientific Construction for the Reduction of Static Interference

High Resonance—Unapproached Selectivity

NO TICKERS NOR ARMSTRONG CIRCUITS REQUIRED for the reception of CONTINUOUS wave signals if you own a MIGNON-SYSTEM CABINET



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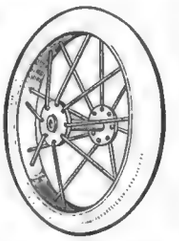

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accurately made of carefully selected wood. All types carried in stock from 6 inches up to 24 inches; made to order up to 7 feet.

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Made of best quality steel rod. Being threaded on both ends and having nuts, they are very fine for CONNECTING TUNERS' ENDS AND LOOSE COUPLER SECONDARIES. Also made in brass at extra charge. 1/16 in. axles up to 6 in., 10c.; 7 to 10 in., 15c.; 11 to 15 in., 20c. 1/8 in. axles up to 6 in., 15c.; 7 to 10 in., 20c.; 11 to 15 in., 25c. Postage, 2c. extra.

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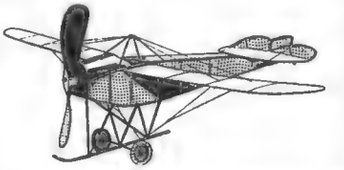
Clean cut, made right; run smoothly without noise or friction. Have 1/16 in. shaft hole but can be furnished with 1/8 in. hole at 10c. each additional. Postage, 2c. extra for each gear.

Size	No. of Teeth	Pitch	Price
5/8 in.	18	32	.15
3/10 in.	10	40	.15
11/20 in.	20	40	.20
4/5 in.	30	40	.25

Build a FLYING Model War Aeroplane



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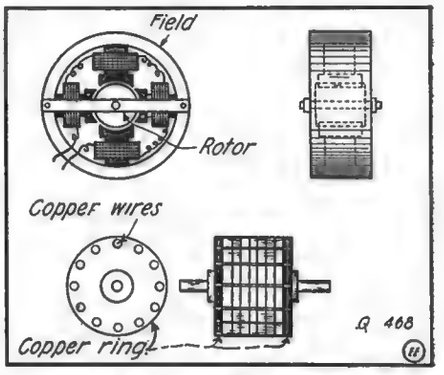
field. This field is provided with a plurality of windings which are connected to the external source or exciting energy. Induction motors are supplied for either single



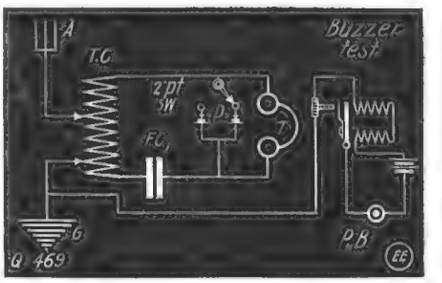
Assembly and Parts of Induction Motor.

or multi-phase circuits; the larger size motors being invariably supplied only for two or three-phase supply. Special windings and starting provisions have to be made for such motors, when adapted for use on single-phase a.c. circuits.

A. 2. Herewith the illustration showing the make-up of the induction motor. The rotating member consists of a number of soft steel discs mounted rigidly on a shaft in the usual manner. These are slotted similarly to a d.c. motor armature, but instead of being wound with coils comprising a large number of turns of wire, each slot receives a single, heavy copper rod or bar. Two heavy copper rings are placed on either rotor end and the copper bars in the slots are firmly riveted or soldered to these rings; thus there are provided a plurality of closed electrical circuits through the end connecting rings or discs and the inductor bars within the slots.

A four-pole field, made up of laminated annealed steel discs, is here indicated, but this is only used in most cases for small, single-phase fan motors and the like. In larger multi-phase motors the field has a large number of slots in the periphery of the rotor opening, which resemble almost identically the peripheral appearance of the rotor. In the stator slots appropriate windings are placed, consisting of coils of magnet wire. The rotor is moved or pulled around by the constantly changing rotating a.c. magnetic field set up by the stator windings.

A. 3. The reason that you obtain different results when using Ohm's law with a.c. circuit is that this law does not apply to a.c. circuits but only to d.c. circuits, due to the former manifesting marked capacity and inductive effects, which throw the current and voltage out of phase or synchronism.



Radio Receiving Hook-up.

THE TESLA PLANT.

(469.) Chas. W. Squires, Port Jefferson, L. I., N. Y., wants us to give: 1. The correct hook-up for a receiving set consist-

ing of two slide tuning coils, two detectors, silicon and galena, two-point switch to throw on either one, test buzzer for detectors and 75 ohm receiver. 2. The wave length of a two-slide tuning coil wound with 128 feet of No. 24 bare copper wire. 3. The location of Nikola Tesla's plant on Long Island.

A. 1. The illustration herewith given shows the proper connections for these instruments.

A. 2. The wave length of the tuning coil would be about 450 meters.

A. 3. This plant is located at Shoreham, L. I.

STEEL WIRE.

(470.) Edward L. Jewett, Sullivan, N. H., inquires of this department: 1. Where he can obtain long lengths of steel wire for use in the telegraphone, described in the June, 1915, issue of *The Electrical Experimenter*. 2. The difference between No. 32 steel piano wire and No. 32 B. & S. gauge wire.

A. 1. The steel wire used in the telegraphone can be bought in any desired length from most hardware stores.

A. 2. There is a difference between the diameter of wire designated as "No. 32 steel piano wire" and "No. 32 B. & S. wire," as the gauge used for measuring steel wire is not the same as that used for copper. The latter refers to the Brown & Sharpe standard gauge.

WIRELESS SCOUTS HONORED.

H. B. Thayer, president of the Western Electric Co., gave a dinner at the Hotel Astor recently in honor of the men who went to the far corners of the earth to receive the wireless telephone messages recently sent from Arlington, Va., and which were heard in Paris and Honolulu.

ELECTRICITY ON OCEAN LINERS.

(*Continued from page* 611.)

in the house. There are two complete sets of apparatus, one for transmitting and one for receiving messages, the latter being placed in a sound-proof chamber in one corner of the house. There is also an independent storage battery and coil.

For submarine signaling apparatus is provided for receiving signals from submerged bells. Small tanks containing microphones are placed on the inside of the hull of the vessel on the port and starboard sides below water level and connected by wires to receivers situated in the port navigating room. The whistles are electrically actuated. The boiler-room telegraphs, stoking indicators and a number of auxiliary appliances, such as rudder indicators, clocks and thermostats, are also electrical, and the water-tight doors are released by electromagnets.

There are complete emergency circuits provided on all ocean liners. A separate and distinct installation is fitted in all parts of the vessel, deriving current from two

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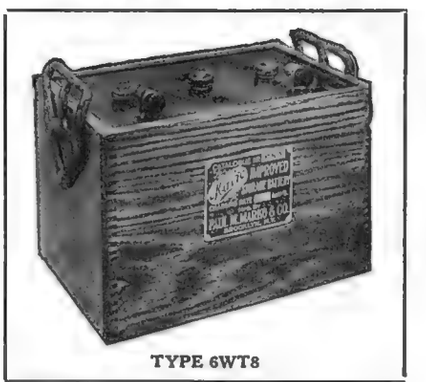

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Type	Volts	Amp. hr. capacity	Length	Width	Height	Special price to wireless engineers
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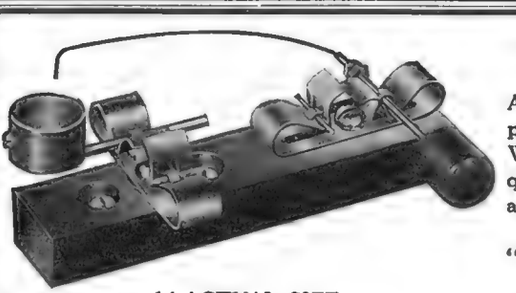

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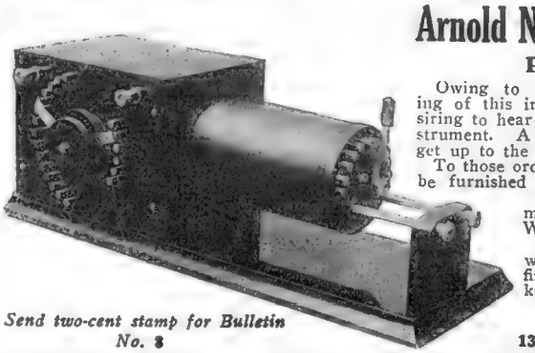

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To those ordering an instrument such Hook-up will be furnished gratis.

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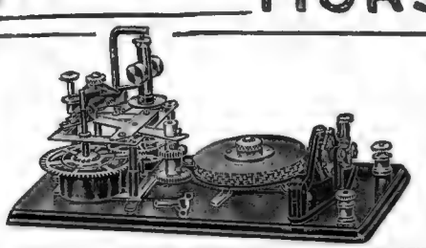

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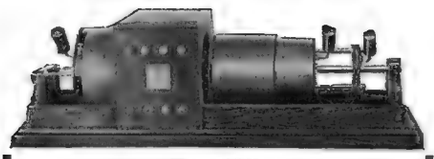

Type AML

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No Taps	No Sliders
No Switches	No Delicate Parts
No "Dead Ends"	All the Wire in
No Contacts	Use all the Time

and is finished in mission oak, genuine cut hard rubber, silver finished wire, etc.

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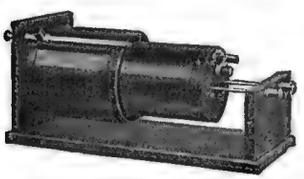

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30-kw. sets and the 3,500-ampere-hour battery, so that in the event of current from the main dynamos being unavailable an independent supply is obtainable. Connected to the emergency circuit are about 500 incandescent lamps, fitted throughout all passenger, crew and machinery compartments, at the end of passages and near stairways; also on boat deck, to enable anyone to find the way from one part of the ship to the other. The following are also connected to the emergency circuit by means of change-over switches: Five arc lamps, seven cargo and gangway lanterns, wireless apparatus, boat davits, mast, side and stern lights and all lights on bridge, including those of navigating and chart rooms, wheel house, telegraphs, compasses and Morse signaling lanterns.

Very soon, it is freely predicted, ocean liners will also be driven by electric power, the Government having ordered such an electrical equipment from the General Electric Co. to drive the new battleship California, the largest in the world.

ELECTRICITY, THE BENEFICIENT.

(*Continued from page 619.*)

great aluminum industry with all its branches, for instance, is directly dependent upon the electric current for the production of the aluminum itself. Acetylene gas which is now used for so many purposes is obtained from calcium carbide, which is produced by means of the electric current. Carborundum, the well-known and widely used abrasive, is a product of one form of the electric furnace. The electric current is used in refining copper on a vast scale, for the purpose of purifying it and for the separation of the precious metals. Numerous other chemical industries are founded upon the use of the electric current. Fixation of atmospheric nitrogen for producing nitrates for fertilizing and other purposes is now accomplished on a large scale by means of the electric current, and it promises to become in time one of the vastest industries in the whole world. In fact, power plants of approximately half a million kilowatts, or more than three-quarters of a million horsepower, concentrated in a single station are now being considered for such production of nitrates. The time is coming when the whole world will be affected by this industry through food production.

Such a catacylsm as the complete cessation of all electrical activities would therefore result in such changes as greatly increased concentration of population around industrial centers, the city and the country would be pushed farther apart, many industries would be disorganized and some would be stopped completely, many great establishments would have to be reconstructed, types of buildings would be changed, methods of business would be modified, the producing capacity of individuals and of industries would be greatly reduced, methods of living would be modified, methods of transportation would be changed and for the worse; in fact, all conditions of life and fields of endeavor would be influenced, either directly or indirectly.

Myriads of times it has been said that "electricity is in its infancy," until people have come to believe that it is a perpetual infant like Buster Brown for instance, but it has now grown to robust stature and unostentatiously has assumed a goodly share of the world's burdens. Its efforts have been productive and not destructive. In this sense it has been one of the most beneficent agents of mankind. In Arabian Nights' parlance it is one of the good genii.

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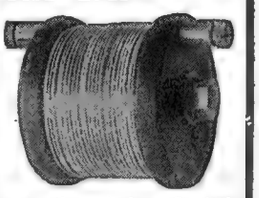

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

FREIGHT CAR LOCK.

(47.) Elmer D. Gehman, Macungie, Pa., desires to have our advice on a freight car door lock which he has invented. He submits description and illustrations of same.

A. The idea to us seems novel and as far as we have ascertained by a careful examination of our files and reference books nothing like the idea submitted is in existence so far. We would, however, advise our correspondent to get in touch at once with a patent attorney to find out what has been done in the art before. It will only cost a small sum of money to get the references of other patents that have been obtained on such locks, and they perhaps will show our correspondent how to go about getting a valuable patent on the invention.

NON-REFILLABLE BOTTLE.

(48.) Ralph H. Zimmermann, Sutton, Neb., desires to know if there is such a thing as a simple and practical non-refillable bottle, and whether one is on the market and in actual use. He also wishes to know if it is worth while to spend time and money in the invention of such a bottle.

A. As stated before to another correspondent, several thousand patents have been taken out on non-refillable bottles, and as far as we are aware, there are not six being used at the present time. The ones that use them are mostly the liquor people, to whose interest it is to see that the bottle is not refilled after its contents have once been emptied.

We have stated the case clearly above and our advice to inventors of non-refillable bottles is that they should not waste a lot of time and money inventing one, as practically everything has been attempted in this art, and several very good ideas are in actual use to-day.

As far as we are concerned, there is no such thing as a non-refillable bottle, as any non-refillable bottle, no matter how well constructed, can be refilled if anybody really wants to do so.

We know of a case where an unscrupulous bartender removed the label of a liquor bottle, the brand of which had a very wide sale. After removing the label, a small hole about ⅛ in. in diameter was drilled into the bottle, and by using an ordinary suction pump the bottle could thus be refilled quite easily with an inferior brand. The small hole was plugged up with cement and the label again placed on the bottle. Consequently the non-refillable bottle could be refilled in spite of the fact that this was about the best bottle of this kind on the market. While such cases are of course infrequent, it still goes to show that where there is a will there is a way.

COMMUTATORLESS D. C. GENERATOR.

(49.) Clarence Ray, Kokomo, Ind., has submitted to us an elaborate set of drawings and description about a commutatorless d.c. generator, and he wants to know what demand there would be for a machine of this kind, and, if possible, its value financially. The dynamo in question works without commutator, as its name implies, and is supposed to have a much larger efficiency than other generators of the same kind.

A. As stated before in these columns, this journal cannot give advice as to the financial value of an invention. We stated before that even if we were to put down a figure this would at best be but a crude guess, as it would be practically impossible to approach the true value within 90 per cent., no matter what the invention was.

As far as the dynamo is concerned as submitted by our correspondent, we must say that we have been very favorably impressed with the idea. We have never seen anything like it, and from a careful study which we have made of the device we are quite convinced that it will work as stated by our correspondent. It is certainly the most ingenious invention which has been submitted to us so far, and should prove of great interest to manufacturers constructing generators. As far as we are aware of, there exists to-day no machine nor patent on a generator of this kind, and we would advise our correspondent to get in touch with a patent attorney at once and see what has been done in the art before. There is a chance that a similar idea might have been patented before, although we very much doubt it.

We have been so well impressed with this invention that we would like our correspondent to advise us what results he has had in connection with the device.

EDISON DEFINES GENIUS.

"Stuff! I tell you genius is hard work, stick-to-it-ive-ness and common sense!"

In this short and trite sentence Thomas A. Edison, the wizard, sums up his successful career. But this versatile and brilliant inventor should have added genius is indefatigable in research, experiment and discovery and exhibits intense concentration of mind and love of learning.

Thomas A. Edison was born at Milan, O., in 1847, but when he was seven years of age his family moved to Port Huron, Mich., where he passed his boyhood. Edison spent but three months in the public schools, but received a thorough schooling at his mother's knee. Before he reached the age of twelve he had read Gibbon's "Rome," Hume's "History of England," Sears' "History of the World," and the "Dictionary of the Sciences."

PATENTS

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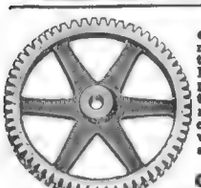

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(*Continued from page 625.*)

soned with a similar logic, and they had thus come to the conclusion that as Mars is so far removed from our sun the temperature on Mars must necessarily always be far below the freezing point. Accordingly they reasoned that life on Mars as we understand it was not possible. But then the telescope suddenly revealed that the Martian snowcaps *do* melt every spring, and if this is the case the temperature even in the arctic circles at times *must* be above the freezing point. But why?

"'The answer is simple enough. The earth has a very dense atmosphere with many clouds. On Mars the reverse is the case, where we have a thin atmosphere and practically no clouds all year around.

"'Professor Lowell estimates that over the earth as a whole the proportion of actual to possible sunshine for the entire year is 50 per cent. In other words, the sun only shines practically one-half of the time it might if there were no clouds. On Mars, on the other hand, the sun shines 99 per cent. of the time. There are no cooling rains or snows in the temperate zones either to cool the atmosphere, consequently a great deal more heat is absorbed and retained on Mars than is the case on earth. Further, an enormous amount of energy is lost on earth, where the sun rays must travel through a dense blanket of air, which is not the case on Mars, where the air is thin and clear. For this and other reasons too technical to dwell upon, we find that light and heat are practically the same on the two planets, with several points in favor of Mars.'

"While I was still turning these facts over in my mind, Flitternix suddenly pointed to the sky and shouted rather excitedly:

"'Look at the moons!' I followed his finger and I saw the wonderful spectacle of two full moons shining in the sky. It was still light and for that reason the effect was not as wonderful as we have since witnessed when we see Phobos and Deimos during the night time. At that particular time the moons shone rather pale as our own moon does in a bright afternoon with the sun still up.

"Phobos, the larger of the two moons, is but 4,000 miles distant from Mars and, as I mentioned before, it revolves around Mars in the incredible short time of 7½ hours. In a single Martian day it therefore revolves three times around Mars, consequently it rotates faster than Mars itself. Although it revolves in the same direction as Mars and the rest of the planets, namely, from west to east, on account of its greater speed *it appears as if it were moving from west to east.* Its speed to an unaccustomed human observer is really disquieting. While we were looking on we could actually see how terrifically fast Phobos moves. When Flitternix had first called my attention to it it was quite high up in the sky. Ten minutes later we watched it plunge with express speed below the eastern horizon! It is positively uncanny to see a heavenly body that looks as big as our moon perform such celestial gymnastics, but the fact remains. Deimos, the smaller of the two moons, revolves at a distance of 12,300 miles from Mars. But as it measures but 36 miles in diameter it naturally appears quite small as seen from Mars, even when full. At that afternoon when we saw it it did not appear very much brighter or bigger than the evening star as seen from the earth. As a matter of fact, it does not look like a moon at all

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to Martians, as we understand that term; it looks rather like a very bright star. Even during the night its face does not always appear as a disc to the naked eye, even when it is full. It is too small and too far removed. Nevertheless it is a true moon.

"Having finished our contemplation of the sky, we turned anew to the view directly below us. Of all inspiring and majestic sights I do not think that there is one that can rival a Martian 'city.' I once thought that New York as seen from the Woolworth building was about the grandest view one could ask for, but it appears positively ridiculous compared with any of the Martian great centers.

"To begin with, the Martian cities are not built upon the ground for a very important reason. Nearly all of the Martian continents are deserts, irrigated only in comparatively small sections and near the great waterways. The land, therefore, which is absolutely flat without even small elevations, is sandy, as are all true deserts. For ages upon ages this desert sand has been rolling back and forward over the planet till it has lost the characteristics of real desert sand as you know it on earth. It has become a fine, impalpable dust, extremely choking if it finds its way into the lungs.

"This fine desert dust is the greatest bane of the Martians and they fight it constantly and heroically. But as nothing but vegetation—which, again, is dependent on water—will permanently stop the dust, the fight is almost hopeless, for the Martians lack water to irrigate the entire planet. Naturally the dust is not quite so bad near the waterways, but the large centers spreading for a few miles inland are not thus protected, especially if the wind blows from the land side over a broad expanse of desert. Even the slightest breeze brings its clouds of choking dust and a strong wind sometimes obscures the sky.

"But when it storms pity the poor Martians! Through the large telescopes on earth 40 million miles away astronomers have frequently seen huge sandstorms sweep over sections of Mars as large as France! Can you imagine what such a storm means? We witnessed one yesterday and it was awe-inspiring, terrific indeed. Hours ahead of the storm the Martians ran for their sheltered lofty houses and closed everything airtight. All traffic on the canals, on the ground, as well as in the air, ceased for two hours while the storm was in progress. From the eastern side of our host's windows we saw the approach of the dust. It came rolling on in gigantic red clouds like an ocean, and although it was in the forenoon the sun was blotted out almost entirely. The dust is so fine that you could hardly hear it as it was hurled against the thick window panes in immense quantities. On and on it came, seemingly without end; sometimes we would get a glimpse of sunlight, but oftener we were plunged in total darkness. After the storm had lasted for two hours it stopped as suddenly as it had appeared and the sun smiled down on us again as always.

"Within ten minutes after the storm myriads of aerial flyers could be seen spraying the buildings and structures with compressed air to clean out the red dust from the corners where it had accumulated. When we looked around this morning there was hardly any evidence of the terrific sandstorm of yesterday. Of course, such storms as the one we witnessed are rare and do not occur more than six times a year; nevertheless, all Martian houses and structures are built with a view of getting rid of the dust as quickly as possible when it does come in avalanches.

"Accordingly all buildings have sharp

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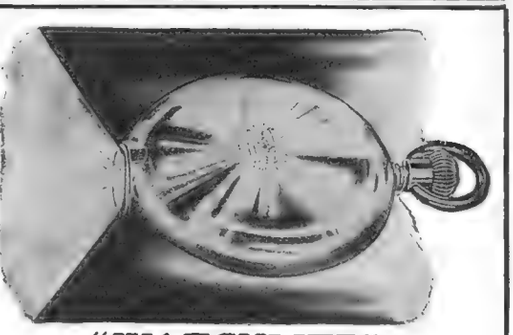
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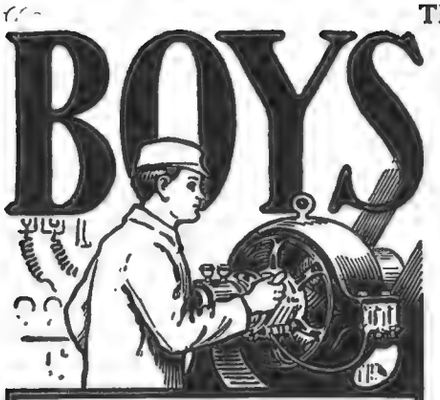

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gable or pyramid roofs, and every wall and balustrade is built with a gable. Every window sill points downward at an angle. There is not a structure on Mars that is exposed which is flat, or which has a single flat projection extending from it. Everything is built to get rid of the dust as quickly as possible, for this fine and extremely dry sand slides down a sharp incline with great rapidity.

"From the foregoing you will easily understand that the Martians cannot permanently dwell near the ground. It is an exceptionally calm day when your Martian can walk on his planet without his respirator hood over his head. From this it follows that as he cannot dwell upon the ground, and as intelligent beings as a rule do not care to burrow themselves into the ground, there is but one thing to do, and that is to go above the surface of the ground. Indeed, this is precisely what the Martians have been forced to do for thousands of years back.

"It was soon found that the ordinary dust did not usually rise higher than 400 feet above the surface of the planet. At this altitude the air is sandproof except for such severe storms as the one we witnessed yesterday.

"For this reason all buildings and structures on Mars, with few exceptions, are located 500 feet above the ground in order to make life bearable. Thus all 'cities' are built high up in the air, and it is this feature which gives the stranger his greatest surprise.

"Imagine immense metal towers stretching skyward mile upon mile, supporting a vast city raised 500 feet up in the air. Imagine these towers partly roofed over with metallic roadways and buildings and you have a faint idea of how a Martian 'city' appears.

"When we had first 'landed' on Mars we naturally thought that we had touched the ground. As a matter of fact, we had not 'landed' at all, but we were still 500 feet away from Mars proper. We simply had descended in the aerial Martian city, but this we did not know till later.

"Every building is constructed of the universal transparent material *Tos*, giving the structures a curious but pleasing appearance. The transparency of this wonderful material is so great that it is possible to actually look straight through an entire building, wherever there are no obstructions of opaque objects. I might say that the latter are rare, for the Martian loves nothing better than transparency and for that reason he builds nearly every object of *Tos;* from a table down to the floor, which, of course, is transparent, too. You might think that such a house, open to everybody's curiosity would bring with it many delicate as well as embarrassing situations, but this is not the case, at least not for the Martians. These people have long since learned that anything worth doing cannot possibly be open to criticism from fellow inhabitants; while closeted, non-transparent rooms make for nothing but laziness and vice. When all of your actions are open to the entire world you are more apt to lead an upright life than otherwise. For that reason no false, make-believe civilization exists on Mars as is the case on earth. For that reason, too, the Martian is an upright, healthy, truth-loving individual, not a hypocrite as are nine-tenths of the human race. The Martian has no secrets, he knows no vice, he has no scandals, and he has little occasion to feel ashamed of himself. Why? Because everyone can see at *all* times what he is doing.

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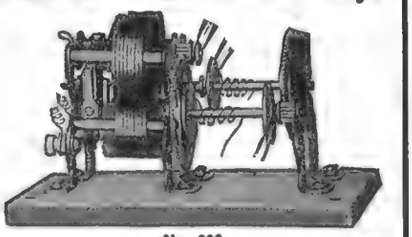

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"The great Martian 'cities' are laid out in semi-circles, or else rectangles, always one side quite close to a waterway. Moreover the 'cities' are not detached, but they are continuous; by that I mean that they run unendingly along the whole length of nearly every waterway. Thus on both sides of the waterways you will find the metal towers bearing on their top the Martian buildings. The so-called 'running cities' are only about one mile wide, running parallel with the 'canals.' Every 50 or 100 miles we find a large center which spreads out in form of a semi-circle or a huge rectangle, some of these large 'cities' recede from five to seven miles from the waterways. Of course, these large 'cities' are connected on both ends with the 'running cities'; for that reason there is no beginning and no end to the Martian 'towns.' Nor do they go by any particular name. Each spreading city has a number while the running ones, located between the spreading ones, have a figure and a symbol like our letters. Thus the Martian Capital at which we reside at present is termed 1. The first large 'city' toward the south is termed 2. The 'running city' which connects city 1 and 2 is termed 1A. Of course, the Martian symbol is not 'A,' this is merely my equivalent or my own translation for it. The numbers of the houses for quick orientation are termed in 'fractions,' according to their location. Thus, for instance, a house located in the 'running city' 1A is numbered $\frac{1A}{10}$. This means that it is the tenth house south, counting from the 'city' 1. As every Martian knows the location of every 'town,' the numbering system is both simple and does not lend itself to confusion.

"As nearly all of the land on Mars is practically desert, except that near the waterways, it follows that no 'town' ever reaches more than 10 miles inland. This fully explains the vast 'connecting cities.'

"All the streets run perfectly straight and cross at right angles, American fashion. All buildings and houses are detached from each other, none are ever found built close together. Usually eight buildings constitute a 'block,' three to each side, with the center space left open.

"The 'blocks' are separated by wide arched roadways; wherever two of them cross each other, there are usually two bridges flung diagonally across which meet in the center.

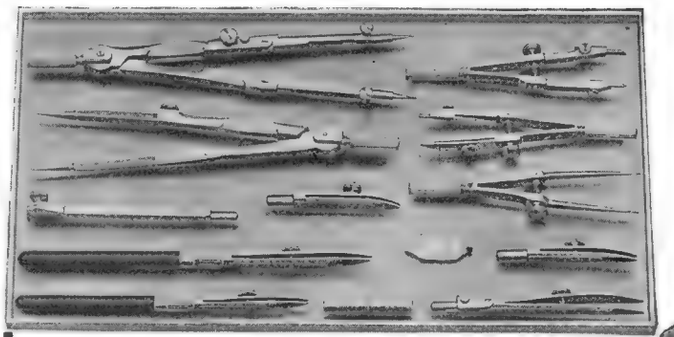
"The roadways themselves are of a heavy metallic construction and are entirely perforated with round conical holes about one inch in diameter with about one inch of metal between them. By this method all dust and dirt falls through the streets to the ground 500 feet below. Thus the roads appear clean perpetually, even after a sandstorm. The houses.....but, hello, my chronometer tells me that I have but ten seconds left to talk before the telegraphone wire on my radiotomatic on the moon will be full to capacity. Well, good night, my boy, till to-morrow, good night!....."

* * * * *

The usual rap, r-r-r-ap, f-flum, f-flumm and everything was quiet once more.

This serial started in the May, 1915, issue. Back numbers are supplied at 10 cents each.

(To be continued.)



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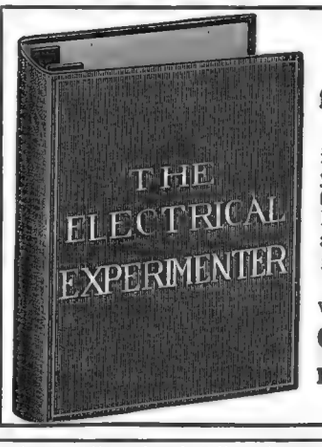

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THE UTILIZATION OF THE SUN'S ENERGY.

(*Continued from page* 606.)

a partial rotation to the ratchet wheel w. As the current ceases the armature is retracted by the spring b, without, however, moving the wheel w. With the stoppage of the current the plates t t cease to be attracted and separate, thus restoring the circuit to its original condition.

Coming now to later developments of a practical nature in the line of solar engines and boilers, we may take up the work of Mr. Shuman, of Philadelphia, Pa., who later collaborated with a Mr. Boys, of England. They were able in their final developments to operate a 100 horsepower engine by means of solar energy. This plant was built at Meadi on the Nile, Egypt, and is shown in the large illustration here reproduced at Fig. 3. Prior to this excellent work, however, we may consider briefly the early solar engines developed and tried out at Philadelphia, Pa., by Frank Shuman, upon which work he started in 1906.

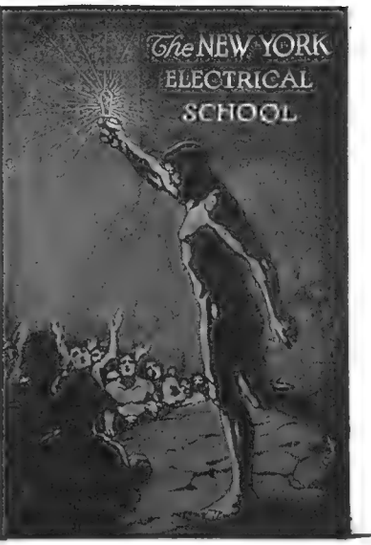
A year later he had running at Tacony, Pa., a practical plant of this type, which developed about 3½ horsepower by using 1,200 square feet of sunshine that was allowed to fall on a fixed, horizontal water box. This box was fitted with a glass top and a series of parallel horizontal black pipes were immersed in the water. These pipes, containing ether, exposed 900 square feet of surface to the solar radiation. The water also became heated and carried the heat to the underside of the pipes, thus realizing a greater efficiency. The ether boiled and its "steam" drove a small vertical, single cylinder engine. The exhaust ether vapor passed into an air surface condenser and the liquid ether from this was pumped back into the tubes of the sun boiler. It was found that this plant worked well even with snow on the ground, which is explainable from the fact that the permeability of the atmosphere is about 20 per cent. greater in winter than in summer.

Further tests and refinements to the Tacony plant by Mr. Shuman resulted in 1911 in an engine and boiler which showed considerable strides forward in their design, the ratio of 245 square feet of sunshine per one brake horsepower having been attained.

It may be mentioned here that the pipes constituting the sun boilers have invariably been *blackened*. For low temperatures lampblack has been used as the absorber, but where high temperatures were required platinum black was used.

The illustration Fig. 3 is that of the solar energy plant built at Meadi on the Nile, Egypt, by Messrs. Shuman and Boys in conjunction with several English scientists, including Mr. A. S. E. Ackerman, B.Sc. This plant made use of a 100 horsepower Shuman engine coupled with suitable auxiliary apparatus, as before mentioned. Five absorbers of the reflection type were utilized, as the illustration portrays. Each one measured 15 feet wide by 205 feet long. These were placed north and south geographically speaking, and were automatically heeled over, by being placed on suitable wheels, from an easterly aspect in the morning to a westerly one in the evening, so as to actually follow the sun. This caused an approximately even absorption of the solar rays all day.

The total area of sunshine so collected at this plant was 13,269 square feet. Cast iron boilers of suitable design were placed at the focus point of the reflectors, as shown in the illustration. They were covered with a single layer of glass which



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SEE PAGE 661

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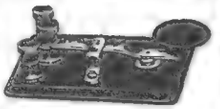

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enclosed an air space around the boilers proper. The concentration value of this arrangement was 4½ to 1. The maximum pounds of steam generated was 12 pounds per 100 square feet of sunshine, or the equivalent, to 183 square feet per brake horsepower. The best hours' run developed, at atmospheric pressure, 1,442 pounds of steam. Hence (allowing 22 pounds steam per brake horsepower) the maximum output for an hour was 55.5 horsepower (about ten times better than any previous results). This means 63 brake horsepower per acre of land occupied by the plant. Moreover, no marked reduction in the horsepower produced was noticeable in the early hours of the morning or in the late hours of the afternoon.

The engineers of the concern which made these tests at Meadi recommended that such solar plants were feasible and practical and that undoubtedly they would be a very good thing in such arid regions for irrigation purposes. One argument brought against them, however, was that the power would not be available in cloudy weather, but then the irrigation would not be necessary, was the reply.

Thus the fight goes on between Dame Nature and the scientists. Whether we shall ever have an efficient solar boiler and engine is a problem worth thinking about and a very interesting one at that, as we possess no greater source of natural energy, to be had without taxation or special leases from some money-grabbing coal, oil or other baron, than that of the sun. Some day we may be able to derive all necessary light and power, for our homes at least, by means of a solar-electric plant located on the roof, and who shall say that we must be taxed for utilizing such energy?

THE TESLA HIGH FREQUENCY OSCILLATOR.

(*Continued from page* 615.)

thousands of horsepower? However, this figures out better than might be expected offhand. With an input of 300 kilowatts at the Tesla coil primary exciting such a structure and considering that this amount of energy is discharged through the earth in six-thousandths (.006) of a second, then the rate of liberation of the energy will be 120,000 horsepower.

Many perhaps would doubt that even with their small experimental high frequency sets, where a high frequency ammeter placed in the high frequency circuit may register but *1 ampere effective current*, yet an average maximum surge for the oscillation passing through the circuit may and often does reach the value of *over 116 amperes*. As the amplitudes of each succeeding high frequency alternation is less than the one preceding it, of course the first oscillations are much higher than the average amplitude just mentioned, and consequently the peak value of the current which flows through the electrode and into a person (who may happen to be connected in series with a 110-volt, 32 candlepower lamp for demonstration purposes) may reach a very much higher figure than 116 amperes.

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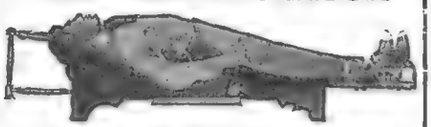

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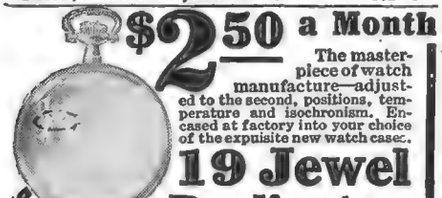

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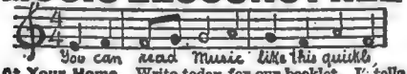

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HOW TO ORGANIZE AND CONDUCT A RADIO CLUB.

(*Continued from page 627.*)

ing and receiving sets constructed entirely by members of the club. The crowds of visitors evinced great interest in this particular feature of the exhibit.

The Atlanta Radio Club has an active membership of 25, each member possessing a complete sending and receiving station. A meeting is held every two weeks, at which many subjects of interest are discussed. The members converse every night with each other, the length of conversation, form of calling, signing, etc., all being done in strict conformance to certain by-laws of the club's constitution.

The club has a *special operator,* who sends out official notices to all members on a certain day and hour, and also has an *inspector of stations,* whose duty is to adjust each station so that it will cause a minimum of interference, and also to see that each station conforms to the Government radio regulations regarding wave length, power, etc.

A Club Laboratory.

Many amateur radio organizations have arranged in one way or another to fit up shop facilities for the use of the members. Special appropriations, obtained by outside contributions or by levying an assessment on the members of the club, have served to offset the cost of the machinery necessary. A small lathe is probably one of the most useful articles which a club should purchase for such a laboratory. This may be followed by a small drill press, another necessary accessory which the individual members would probably not have the good fortune to have the use of in their own homes or laboratories. Aside from such machinery necessary in winding coils, making up special apparatus parts, etc., there is a very urgent need for a good *wave meter,* and also, when possible, a *decremeter.* From the various magazine articles, particularly in *The Electrical Experimenter* for November, 1915, it is possible to build a fairly accurate wave meter without a special calibration against a standard wave meter. Any wave meter can be calibrated at a nominal expense by the Bureau of Standards, Washington, D. C. The secretary of the club should write to the bureau, obtaining in reply information as to the cost for calibrating the particular instrument in hand. Likewise, it is possible to have a decremeter calibrated. If access is had to any local school or college having such standard instrument on hand, it is possible that arrangements can be made with the instructor in charge to compare and check up the club's instrument with same.

[*Be sure to read the conclusion of this important article in the April issue. It takes up such timely subjects as the "Rules for Conducting a Meeting," "Order of Debate," "Formation of Club Library," "List of Most Desirable Books," etc.*—EDITOR.]

THE CHORALCELO, A WONDERFUL ELECTRIC PIANO.

(*Continued from page 607.*)

necessary to place within them a small piece of iron, so that the electro-magnets may attract them. Instruments which are operated by this method are depicted in Fig. 3. The one toward the right is an instrument which imitates a flute. The electro-magnets are placed underneath the tubes, which are made out of wood and act as resonant chambers. The magnets are caused to act on iron discs mounted at the lower end of the tube. Another style of flute instrument is illustrated in Fig. 4. This employs a different variety of tubes, ranging from a very high tone to a very

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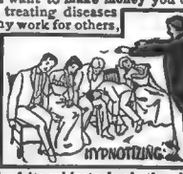

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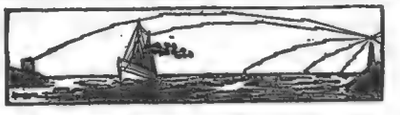

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low one. The smaller pipes emit the latter tone, while the larger ones produce the former.

The instrument shown in the center of Fig. 3 illustrates a brass chime. The tones are produced by hammers, each of the tubes being supplied with one. These are operated by electro-magnets, as perceived in the upper bracket of the stand. These are also connected to the same keyboard.

The very deep tones of an organ are produced by vibrating diaphragms placed beneath metal horns. A pair of electro-magnets are held a minute distance away from the diaphragm and serve to vibrate the latter when the pulsating current is applied. The volume of the tones are powerful and are very low. By increasing the power in the electro-magnets the strength of the tones are so much increased that it is almost impossible to imagine the effect.

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We are indebted to Wilber E. Farrington, of the Choralcelo Co., for our illustrations.

MARVELS OF MODERN PHYSICS.

(*Continued from page 623.*)

a heat wave, that it had a density of about $\frac{2}{3} \times 10^{-20}$ pounds per cu. ft., which would make a volume of ether the size of the earth weigh only a small fraction of a pound.

Whether the ether is continuous or discontinuous, at least it is not matter in the ordinary sense, and it certainly is not atomic; that is, divisible into particles akin to atoms. There are no gaps as would exist between such particles, and the shortest light waves are carried by it as well as the longest. Likewise we now see that it is the universal medium of action for several different and wonderful forces.

To gain a mental picture of this medium let us consider a hollow sphere H, H^1, as in

(*Continued on page 667.*)

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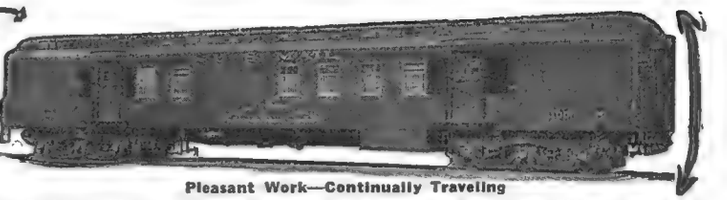

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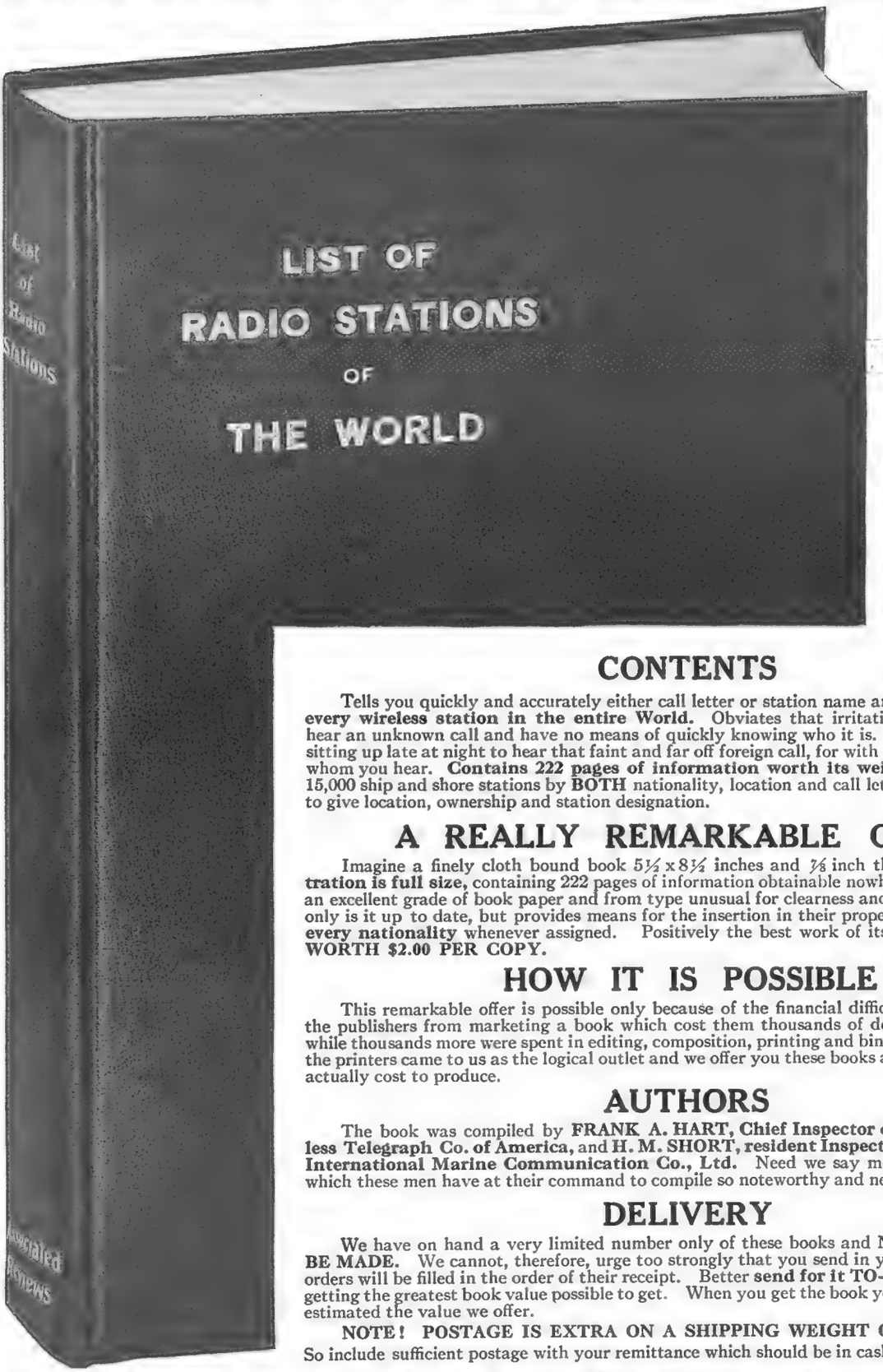

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The book was compiled by **FRANK A. HART, Chief Inspector of The Marconi Wireless Telegraph Co. of America,** and **H. M. SHORT, resident Inspector (U. S. A.), Marconi International Marine Communication Co., Ltd.** Need we say more as to the authority which these men have at their command to compile so noteworthy and necessary a book?

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MARVELS OF MODERN PHYSICS.

(*Continued from page 665.*)

Fig. 3, consisting of two hemispheres connected by a coiled spring on the inside. Now we may consider these hemispheres as uncharged or rather the positive and negative charges exactly balancing each other when they are together. If now the hemispheres are electrically charged in a suitable manner, we may consider the positive as separated from the negative, and the two hemispheres as stretched apart. There is a strain in the ether between these two charges that is analogous here to the tension of the stretched spring.

Take a charged Leyden jar for example. Here we have two opposite charges bound to each other by the strain existing in the intervening medium. The mechanical illustration of this in Fig. 4 is almost self-explanatory. A rope attached to two springs passes over two pulleys. The weighted ends of the rope are the coatings of the Leyden jar, and an excess of weights on one side or the other constitutes the charge. Here the strain between the coatings is shown by the springs again, and if the weights are suddenly evened up, the oscillatory nature of the spark discharge would be aptly illustrated, for the springs would vibrate back and forth "charging" and "discharging" the coatings till equilibrium was reached. Now it is very much a question of whether electricity is a function of the ether or vice versa; that is, whether the electric charge causes the ether-strain or whether the ether-strain causes the charge. One is certainly the accompaniment of the other apparently.

The fact is evident, however, that the ether is a medium for the exertion of forces, either electric or magnetic, and it seems that gravitation is still a third form of ether-strain. Little direct connection is seen yet between it and the other two, but then it must be remembered we know but little of the exact nature of any one of them or even of the "ether." We must content ourselves to live and learn, even though the learning at times seems slow.

[This is the second of a series of papers specially prepared for *The Electrical Experimenter* by Mr. Rusk. Part I appeared in the February issue.—EDITOR.[

A NOVEL RADIO INDUCTIVE TUNER.

(*Continued from page 628.*)

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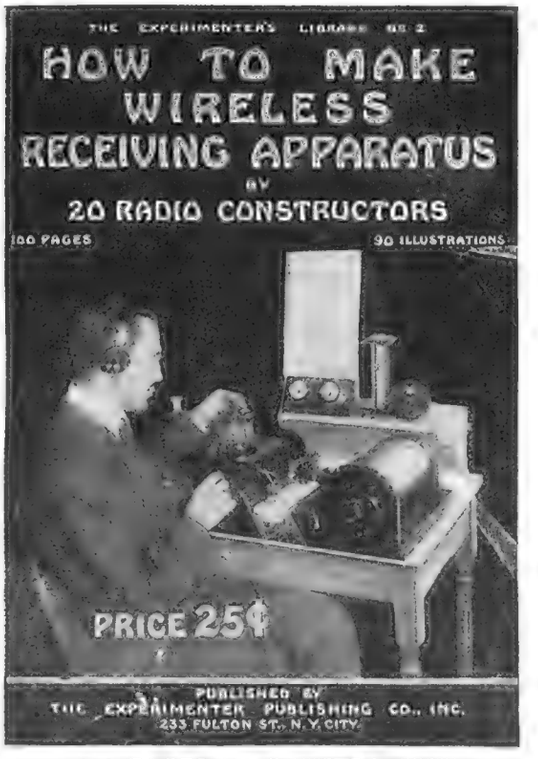

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KILLING THE SMOKE NUISANCE ELECTRICALLY.

(*Continued from page* 610.)

lately in precipitating acid mists, such as are generated in acid producing plants. Figs. 7 and 8 illustrate an experimental outfit for such a purpose. The large circular drum carries a helix of wire which serves the purpose of a ground, while another terminal is placed inside the drum, in the usual way. The connections from the high tension transformer are made to the helical coil and the interior conductor respectively. The pan on which the precipitator is placed is used for collecting the condensed mist which is being generated by the acid making apparatus. Fig. 7 shows the precipitator when the current is off, while Fig. 8 depicts same when the current is on. Note the difference between these illustrations.

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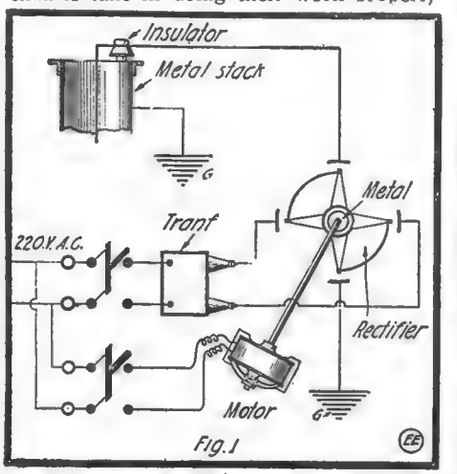

Fig. 1. Diagram of Electrical Smoke Precipitation.

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(Continued from page 630.)

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VARIOMETER type tuner, marble base, 60-point switch on primary, 30-point switch on secondary wound with green silk wire, tunes up to over 2,500 meters; first $15 takes it. Chas. W. Mallory, Box 127, Monongahela, Pa.

FOR SALE—Small wireless outfit for $5. Harry Ostness, River Falls, Wis.

WANTED—½-horsepower, air cooled upright gasoline engine, second-hand, without spark coil. State cubic dimensions, weight and price. Wilbur Guenther, Shelby, O.

SELL OR EXCHANGE—Mandelette 1-minute camera, in excellent condition; want 2,000-ohm head set, loose coupler or other wireless instruments. If interested, write. Stephen McIntosh, Meredosia, Ill.

FOR SALE OR EXCHANGE—Large electric train outfit, cost $19; sell for $10; also Mascot tuner, 90c.; Crystal detector, 60c.; would like loose coupler and Brandes Superior 'phones and $3, or Crystaloi type AA and Brandes Superior 'phones and $3 for train. Henry Cole, R. R. 13, Broad Ripple, Ind.

WILL EXCHANGE $5 electric mirroscope, good condition; want pair 2,000-ohm Murdock 'phones with double head band. All letters answered. Frederick Walters, Amityville, N. Y.

FOR SALE—Two 1-k.w. laboratory transformers, never used; in steel cases; 110 to 50 volts; for moving picture arcs or electric furnaces, $7.50; several reels moving picture film, $1.50 each; one 1/16 horsepower Diehl motor, 220-v. A. C., new, $8; will trade. For more information write Gregory Fay, 1024 Bellevue Ave., Syracuse, N. Y.

SALE OR EXCHANGE—No. 3 folding Brownie, complete outfit, two 2¼x3¼ Premos developing tank; films to both; 32 revolver, $5 Waterman pen, Crusader bicycle $20, unused; large amount of 5c. novels, good pair roller skates; want 2,000-mile Electro receiving set; will sell other things. What have you? M. Hendricks, Ingleside, Ill.

FOR SALE — Two-cylinder, 12 horsepower, air-cooled automobile engine, complete with magnets, carbureter crank, $15; Adams Morgan $6 loose coupler, $2; 6-in. water motor, $2. Clarence Vaughan, Middletown, N. Y.

FOR SALE—½-k.w. transmitting set with Packard transformer, Murdock condenser and oscillation transformer, gap and key; worth $30; condition perfect; sell or exchange separately for receiving apparatus. Thomas Hunt, Abingdon, Mass.

WANT National automatic Morse transmitter or an omnigraph cheap, for books and cash, and in good order. J. M. Keating, 8 West Center St., Beacon, N. Y.

FOR SALE—One 2,000-ohm telephone ringer and bells, never used, $1.50; 1 type S. motor, armature needs rewinding, $1.50; 3 lbs. No. 36 enameled wire, $3.50; primary and secondary for Blitzen loose coupler wound with bare wire, never used, $1; 4,000-meter loading coil wound on tube 6 inches diameter and 8 inches long, 50c.; complete parts for Blitzen variable condenser, minus case, never used, $2; 1 dustproof detector case, 7½x13½x4 inches, $1. All the above sent postpaid anywhere in the United States. Edw. C. Schurch, Deer Lodge, Mont.

SELL OR TRADE—38 revolver, belt and holster, $5; 32 revolver, belt and holster, $3; Kodak with portrait attachment, $7; 4x5 camera, $3; 22 special 13-shot rifle, $10; 25 volumes Dumas novels, part leather, $25. All above articles are in excellent condition. Want complete wireless receiving station. Must receive 1,500 to 2,000 miles, or what have you? Inclose stamp for reply. Mr. H. E. Nelfe, LaFarge, Wis.

WILL SELL audion detector and one-step amplifier set for $35; will pay cash for 1-k.w., 25-cycle transformer. Gordon Obersteimer, Station C, Buffalo, N. Y.

BARGAINS—Murdock loose coupler, $4.50; Murdock loading coil, $1.80; Eastman Kodak, No. 1. Jr., $4; all in excellent condition. Wm. Ranft, 4107 Belle Ave., Baltimore, Md.

EXCHANGE — Complete McGraw-Hills Power Plant Library, 8 volumes new, cost $12, for RJ type audion or sanitary rolltop desk. Meade, 975 Putnam Ave., Brooklyn, N. Y.

EXCHANGE—Two-inch Bulldog coil and $5 Mesco adjustable wireless key for RJ type audion. Meade, 975 Putnam Ave., Brooklyn, N. Y.

MIGNON cabinet R. L. C., 3 special 10,000 meters, including 3,000-ohm telephones; sacrifice for $29; excellent condition. F. B. Meeker, 1632 University Ave., New York.

HAVE one new Premo Junior Kodak, 2¼x3¼; 1 type S dynamo; would like to exchange for water motor, not less than six inches. Thomas Alsobrook, Hosford, Fla.

RECEIVING set (loose coupler, two variables, one fixed condenser, loader, perikon detector) mounted in cabinet, tunes 4,000 meters; $12, $12.50; Winchester 20-shot, 22 rifle, good condition, $7, or exchange for equal value; variometer, $1; want gooseneck audion socket, Murdock loader, variables. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—Complete wireless transmitting and receiving sets, including ¼-k.w. Thordarson transformer, rotary spark gap, Bunnell brass key, oscillation transformer, 2 sections Murdock condensers, 2 Leyden jars, kick-back preventers, lightning switch, loose coupler, Murdock variable condenser, E. I. Co.'s fixed and variable condensers, Ferron and Crystal detectors, Brandes Trans-Atlantic type 'phones; in same condition as when bought, cost $82.50. Make an offer or send stamp for photo. B. D. Arata, 5154 Cates, St. Louis, Mo.

SALE OR TRADE—One $5 medical battery, 2 telephone induction coils, 1 22-cal. rifle, 1 pair ice skates, 30 25c. books, etc. Send for complete list. A. Edington, 424 Butler St., Ft. Wayne, Ind.

WANTED—One double pole, 1,000-ohm receiver, head band and cord; have gum boots, size 5½, worn twice, fine condition; 1 pair new $2 ice skates. Write H. F. Happoldt, 2743 Germantown Ave., Philadelphia, Pa.

WANT ½-k.w. wireless transformer (used E. I. Co.'s preferred), also high frequency adjustable condenser; will pay cash. C. Ehrenberger, First National Bank, Chicago, Ill.

SWAP—One Bunnell giant sounder, new; 1 Little Hustler motor, almost new; 1 4-in. horseshoe magnet, for 1-in. Bulldog spark coil in good condition. E. Servan, Lumberton, N. J.

HAVE violin, accordeon, flashlight, harmonica, books, chemical laboratory supplies with chemicals never used; will trade for receiving and sending station, must receive at least 1,500 miles at night and send 10 miles. What have you? Write for description. Articles all in excellent condition. Address J. G. Schroeder, Box 31, Wisner, Neb.

A BIG BARGAIN—Will give a $4 horn free with a Smith motor wheel for $40; no trades. Arthur Sager, 941 Superior St., Appleton, Wis.

FOR SALE—$6 Meccano set in good condition with $1 worth extra parts. F. Crapser, 418 Jamaica Ave., Brooklyn, N. Y.

WANTED—¼ or ½ k.w. transformer; have for exchange mandolin, stamp collection $20, spark coil, hikemeter, Stevens 22, books, small typewriter. All letters answered. Adelmer Bryon, Ridgefield, Conn.

EXCHANGE—Xylophone, two octaves chromatic scale for "Edison" cylinder machine with recorder; trade motorcycle for glider or motion picture camera. Robert Bullock, York, Neb.

HAVE number of 2-point rubber base switches, new detachable key; bargains; 25c. each. John Means, 44 Zachary St., Atlanta, Ga.

EXCHANGE — 1/10 horsepower speedy, variable speed General Electric motor, almost new; would like rotary variables, or what have you? Zadig, 33 Vernon Ave., Long Island City, New York.

I HAVE 30-in., 8 plate Waite & Bartlett static machine, full set of electrodes, X-ray attachment with tube; no use for same. No reasonable offer refused. All letters answered. Make offer, money or exchange. Harry P. Noll, 1000 Packer, Williamsport, Pa.

FOR SALE OR EXCHANGE—One small receiving set, 1 four-forty storage battery, 1 large 2,500-meter cabinet receiving set. Write or call. C. E. Littlefield, 2672 Mansfield Place, Sheepshead Bay, New York.

FOR SALE OR EXCHANGE—Electric train, engine, three cars, 16 sections of track and one pair of switches, cost $9 when new; will sell for $5, or what have you electrical? Clarence Paulus, Kampmeier St., Burlington, Ia.

FOR SALE OR EXCHANGE—½-k.w. sending set, Boston key, etc.; Blitzen receiving cabinet set (new), and Brandes 'phones, cost $33; audion with X grade bulb and batteries (60 volts), for ½-k.w. Hightone set, or what have you? Frank Marshall, 517 W. Delaware, Toledo, O.

I WANT a static machine, omnigraph, 8 to 12-in. spark coil, storage batteries 6 to 10 volts, 60 to 100 amperes, hot wire ammeter, Tesla coil, fluoroscope, tape register, coherer, electrolytic interrupter, antenna switch, dynamo, or generator (10 to 50 volts), Red Devil water motor, rotary gap, pole-changing switch, galvanometer, 110-volt meter and ammeter, ½-k.w. transformer, with oil condenser and helix. I will pay cash for these articles or will trade. What do you want? R. W. Williams, 826 First Place, Plainfield, N. J.

FOR SALE OR EXCHANGE—2,500-meter loose coupler, D. C. motor, and other items. Send for list and pictures. Want variable condensers and offers. J. W. Kidd, Niles, O.

HAVE telegraph, $1; long-distance telephone receiver and cord, 75c.; two 1-foot rods and sliders, 50c.; all for $2, or trade for wireless instruments. C. Fitch, Dalton, Mass.

FOR SALE CHEAP—Complete, new seven-piece wireless receiving set, with large aerial; made by Electro Importing Co. Albert Grant, Toms River, N. J.

FOR SALE—Several hundred copies of "Golden Hours" and "Golden Days." Send stamp for lists and prices. Samuel Olnhausen, 824 Chester Ave., East Liverpool, O.

FOR SALE OR EXCHANGE—Complete sending and receiving set, cost $100; sell $40, or exchange for Victrola. Frederick Gittelbauer, East Rutherford, N. J.

EXCHANGE—Pair of Winslow's hockey skates, clamp, cost $3; want 100-amp. lightning switch. W. N. Curry, Sweet Springs, Mo.

FOR SALE—Two 2,500-meter, navy type loose couplers, $10 each; one ¼-kilowatt oscillation transformer, $1.50; and a 6-volt Knapp motor, stands 5 inches high, $1. Henry Forbes, 3532 Eleventh Ave. So., Minneapolis, Minn.

EXCHANGE—Six-inch bench lathe, chuck, slide rest, 80-watt dynamo, 6-v. battery charger, 2-horsepower Indian engine; want rolltop desk, Ford Master vibrator for SS dynamo, Remy magneto and coil 2-cylinder, $12; Briggs 4-cylinder and coil, $8; 4x5 box camera, $2; 2-horsepower dynamo castings (rough), $10. Inclose stamp for description. G. F. Silliman, Sardinia, N. Y.

FOR SALE OR EXCHANGE—Westinghouse rectifier, A. C. 110-volt, D. C. 25-volt, 10-ampere; good condition; $35, or will take audion detector as part in exchange. J. H. Wildt, 614 N. Lombardy St., Richmond, Va.

FOR SALE OR TRADE—One pedometer Columbia bicycle lamp, small mechanical drawing set, tie pin for flashlight, fountain pen flashlight, potentiometer; all in good condition; want X-ray bulb, variable condenser, Crystaloi detector. All letters answered. Francis Crump, Jr., Columbus, Ind.

SALE OR EXCHANGE—22 Stevens rifle, $3; long telescope, $2; water motor, $2; wire telegraph set, 75c.; parts of telephone, $2; parts 1-in. spark coil, $1.75; revolver, nickel, fountain pen, flashlights, 50c. each; silicon detector, rotary disc, ear cushions, 75c. each; want transformer coil, Edelman's "Experimental Wireless" and "Experiments," variables, parts of navy receiving transformer, burnt or broken audion bulb. L. Mason, Alden, Minn.

FOR SALE OR EXCHANGE—Several A. C. and one D. C. arc lamp; will sell or exchange. Burgess Stewart, 222 Main St., Huntington, W. Va.

I HAVE many things to sell or exchange. Write for list now. All letters answered at once. George Sharp, 73 Everett Ave., Providence, R. I.

HAVE single and 16-shot 22 rifles, portable drilling machines, coasterbrake bicycle, 4½-horsepower engine, clutch transmission gearing, all gears for attaching to buggy. Write for description. Want motorcycle or cash. H. Reagan, Box 95, McBrides, Mich.

FOR SALE—1A Premo camera (2½x4¼), $2, cost $3; Type SS dynamo, $2; 22 rifle, Winchester, $2; film pack tank, $1, A1 condition. L. A. Madison, Kingman, Me.

FOUR-STRAP switchboard to exchange for spark coil; also have telegraph sounder and 150-ohm relay. H. Lince, Allegan, Mich.

FOR SALE OR EXCHANGE—3A Eastman Kodak in case fitted with Ziess Tessar IIB lens, multispeed shutter, 1 sec. to 1/500th, plate adapter, 2 new plate holders, case 6 extra lenses, 4-section telescope tripod, cost $100.80; also Gibson mandolin almost new, "flat," in black leather case, cost $57.50. No reasonable offers refused. G. H. Dodson, 200 Sylvan Ave., Leonia, N. J.

WIRELESS receiving set, comprising a single slide tuner, new silicon detector, condenser and 75-ohm receiver, $4. Elmer Baier, 444 Seventh Ave., Brooklyn, N. Y.

WANTED—Six Murdock molded condensers. Write telling how many you have and what you want. Have two quenched gaps, etc., or will pay. R. D. Zucker, 46 Clinton Place, Mt. Vernon, N. Y.

EXCHANGE new $115 audion receiving set for twin motorcycle, 1913 model or later. Must be in first class condition. Photo sent to interested parties, also loose coupler for 'phones or hot wire meter. Wm. Lohr, 592 Miller Ave., Columbus, O.

FOR SALE—Complete I. C. S. Reference Library sets of the Structural Engineering, Gas Engines, Surveying and Mapping, and Spanish Language courses. Italian home study outfit. Text-books on shorthand, typewriting, mechanical and architectural drawing, foreign languages, etc. Colt 32-cal. automatic pistol and 38-cal. police positive special revolver. No. 2 Bull's-Eye kodak. Several sets drawing instruments, scales, protractors, slide rule, etc. Mandolin, metronome, music stand and satchel. Pope twin motorcycle. No. 5 L. C. Smith typewriter. No exchanges. Write for description of articles interested in and prices. Eugene Lewis, Haley Road, Kittery Depot, Me.

FOR SALE—W. B. Duck's Code Learner, 90c.; U. S. S. detector, $3; one year Boys' Magazine, 75c.; 29 Modern Electrics and World's Advance, $2.90; 8-inch permanent audion magnet, 60c. T. Waldie, Jr., 21 Woodbury St., Beverly, Mass.

EXCHANGE—Shotgun, rubber shoes, bracelet, 6-v. motor, fishing rod, Hampton watch works, razor, books; want violin, protectograph, coil, most anything. Write. Box 322, Glasgow, Mo.

1,000 WATT nitrogen light, good condition; will exchange for 6-60 storage battery or one-inch spark coil and voltmeter or ammeter. Albert Kennedy, 1852 E. 75th, Kansas City, Mo.

CASH paid for audion bulbs. Apply E. W. Farmer, Box 403, Farnham, Quebec. Correspondence answered.

HAVE Type S dynamo, polishing head and telegraph instruments; will trade for good receivers or Type AA crystaloi, or what? Other articles for trade. Fred E. Egan, Missouri Valley, Ia.

FOR SALE CHEAP—Wireless receiving set, consisting of double slide tuner, silicon detector, two condensers, buzzer test with key and one No. 3 1,500-ohm receiver; all new; first $5 takes set. L. J. Knittel, 53 Wilkins St., Rochester, N. Y.

WANTED—Audion bulbs, burnt out or good; variable condensers, few pounds No. 30 silk insulated copper wire for cash. All letters answered. Wm. Bohn, 1515 Second Ave., New York City.

WILL exchange a new $25 Betz-Tesla coil for a 12-ga. Winchester or Remington pump gun, equal value in Murdock sending condenser, audion detector or amplifier, stranded bronze wire, or $10 cash. John B. Hawley, Jr., 912 College Ave., Ft. Worth, Tex.

FOR SALE—Blitzen receiving cabinet set; hand bench punch, weight 130 lbs.; metal splitting shear, weight 100 lbs. Write for particulars. C. F. Lee, 1417 Belleplain Ave., Chicago.

FOR SALE—Four galena detectors, 30c. each; postage extra. Clinton Stanley, 153 Mariner St., Buffalo, N. Y.

LOOK!—A bargain. Complete navy type loose coupler receiving outfit; mounted on cabinet type base, mahogany finish throughout; uses switches for all tuning, also has dead end switch and detector shunt; very accurate tuning possible; price only $10. George W. Hansen, Carney Ave., Marinette, Wis.

FOR SALE—Complete two-kilowatt transmitting outfit for $55; operates on 110 volts, 60 cycles, alternating current; consisting of transformer, condenser, helix, spark gap and 10-ampere hot wire meter. Or will sell instruments separately as follows: Two-kilowatt transformer, $25; 14 copper-plated Leyden jars in case, $30; helix with spark gap inside, $6. Everything in first class working condition. Are you a bargain hunter? Here is your chance. Write to-day. Sidney Friedrich, 350 East Commerce St., San Antonio, Tex.

FOR SALE—An E. I. Co. 8-volt, 10-ampere dynamo; new and slightly used; will sell for $5.50. Winston Coleman, R. R. 7, Lexington, Ky.

EXCHANGE—Rep. rifle, watch, coil, 2,000-ohm 'phones, Elec. and Mech.'s from 1906 to 1913; want "Amateur Work" magazines; can pay cash. Harold E. Hickey, 1435 Howard St., Philadelphia, Pa.

FOR SALE OR EXCHANGE—Single barrel shotgun, No. 12, value $6; 2,000-ohm double head set, value $5, for a 1½-in. transmitting and loose coupler receiving set, or what? Harry Thomas, Mound City, Mo.

BARGAIN for $5—½-in. spark coil, 1 Gernsback gravity relay, 1 zinc spark gap, 1 coherer and decoherer and 1 strap key, all E. I. Co.'s make, cost $7. Waldo C. Buck, Britton, S. D.

FOR SALE—Gasoline engine with stand, coil and gas mixer. Write for photo and particulars. Irvin Weaver, 1637 Xenia Ave., Dayton, O.

WANTED—To buy or trade wireless goods or Meade bicycle for complete electric lighting outfit for small house, small gasoline, kerosene or motorcycle engine. L. Fulton, Muses Bottom, W. Va.

SELL or exchange 2x2-in. vertical, one-cylinder, air cooled gasoline engine; has new piston, cylinder, coil and carbureter. Fisher Ames, Massena Springs, N. Y.

TO TRADE for good long-distance time receiving set, Mark Stern mandolin with case, small brass upright microscope and Mandel one-minute baby postcard camera. All inquiries answered. Robert Bray, Big Timber, Mont.

FOR SALE—Lathe, water motor, and several wireless instruments; cheap. Call evenings or write. H. A. Gilman, 156 Jerome St., Brooklyn, N. Y.

FOR SALE CHEAP—1½-in. coil, new 6-cup detector, tested mineral, piano finish base, gets long distance; at half price; guaranteed satisfactory. Write D. M. Danvers, 1109 N. Francis, Oklahoma City, Okla.

HAVE two watt meters, one folding vest pocket camera, one box camera, 2A Brownie; want pair wireless receivers, 3,000 ohms; must be in good condition. What have you? Lowery Simmons, Van Alstyne, Tex.

FOR SALE OR EXCHANGE—(E. I. Co. goods: Transatlantic 'phones, rotary and fixed condenser) 5-disc omnigraph, Duck's Ferron detector, large home-made loose coupler and spark coil, helix, key; 5 volumes Musical Educator. Would consider I. C. S. steam engineering volumes, engineers or mechanics' tools. John Methven, Box 171, Ronald, Wash.

FOR SALE—$4 Massie wireless key, or will exchange for Brandes Superior receivers; will pay extra. Emmet Faacks, 413 Fourth Ave. S., Minneapolis, Minn.

ANXIOUS to get and will pay cash for bound volumes 1 and 2 of "The Electrical Experimenter." James Donahue, 857 Vernon Park Pl., Chicago, Ill.

FOR SALE—Electro goods in fine condition. Galena detector, opal glass base, 95c.; 2,000-ohm Junior wireless 'phones, $2.90; 5,000-wave meter loading coil, $1.90; zinc spark gap, 30c.; telegraph key, 25c.; Junior tuner, $1.60; Junior fixed condenser, 40c.; one-inch Bulldog spark coil, $3.25; sold separately, or all for $11. Ralph Thompson, Wooster, O.

WILL TRADE an E. I. static machine for a small variable condenser. H. W. Reichle, 550 Seventh Ave., Pittsburgh, Pa.

FOR SALE—$6 Radio Equipment Co. loose coupler brand-new, tunes 2,000 meters, $4.50. MacDonald, 36 East Tulpehocken St., Philadelphia, Pa.

SWAP — Brand-new Eastman's 3A Postcard Brownie camera for about 2,500-mile range wireless receiving set. E. Haugerud, Scappoose, Oreg.

FOR SALE—New 1,000-ohm single receiver, $1.50; first class sounder and key, $1; Marlin 22-cal. repeater, fair order, $4. Sidney Cook, Victoria, Ill.

FOR SALE—Wireless which receives 2,500 miles; first $10 takes it; also a half-inch coil, $1. Kenneth L. Jennings, Mattapan, Mass.

AUDION detector and one-step amplifier combination, $35; complete ¼-k.w. transmitting set has rotary gap; Blitzen transformer, etc., $22.50; other apparatus. L. Gebhard, 1127 Ellicott St., Buffalo, N. Y.

FOR SALE—Practically new wireless instruments; Blitzen, De Forest, and other reliable makes; also books and magazines. Write. Withers Gavin, Corinth, Miss.

FOR SALE—2,500-meter loose coupler, 1-in. spark coil, detector, spark gap, key, switches and parts for a cabinet set. Inquire of Karl Haberstick, 74 14th St., Wheeling, W. Va.

HAVE brand-new Scout No. 2A with printing and developing outfit, cost $6; will exchange for E. I. Co. 1-in. spark coil, Bulldog type. J. Howard Kelley, Franklin, N. H.

FOR SALE—Loose coupler, $1.50; 22 rifle, $1.50; violin, $2.50; $5 football, $2; ½-in. coil without vibrator, $1; two 1,000-ohm receivers, $1.25 cash. John W. Carroll, McComb, Miss.

FOR EXCHANGE—A Colby receiving transformer, tunes 5,000 meters, and a 1½ coil for a National automatic telegraph transmitter with records, without key or sounder. Frank Spencer, 289 State St., Auburn, N. Y.

BARGAIN—E. I. Co. electrolytic detector and rheostat, $1.25; good condition. L. Loase, 4704 Park Ave., Bronx, New York City.

FOR SALE—Electro potentiometer, 95c.; electrolytic detector, 85c.; single slide tuner, $1.25; Mesco double slide, $2.50; mineral detector, $2.75. Vincent Natalish, Jr., 68 West 56th St., New York.

FOR SALE—Receiving outfit, receives 2,000 miles; will receive time from Arlington. Make offer. John Fouhy, 1428 Blue Hill Ave., Mattapan, Mass.

BIG SNAP—One Ives Electric train; practically new, 3 pieces, 8 straight track, 8 curved, value $5.75; want $3. H. Ananiantz, 700 W. Washington St., Los Angeles, Cal.

FOR SALE OR EXCHANGE—A 6-v. 6A dynamo motor that cost $12.80; three 2-volt, storage batteries, never used, $2 a piece, and 6 different-sized flashlights without batteries. Kenneth Jennings, Mattapan, Mass.

HAVE No. 2 camera; Stevens "Crackshot" rifle, $8; medical coil; want telegraphs, Kodak, photo album, wireless or boxing gloves. Elwell, 115 Cox Bldg., Rochester, N. Y.

FOR SALE—Electro Importing Co. instruments, used one week. Loading coil, lead peroxide detector, potentiometer, 50-ohm relay, half-inch spark coil, small spark gap. Write for bargain prices. C. Alleman, 1408 Madison St., La Crosse, Wis.

FOR SALE—BIG BARGAINS.

$7.50 Electro Loose Coupler	$5.00
$5.50 Electro Spark Coil (1½ in.)	$3.75
$4.50 Radioson Detector	$3.00
$4.00 Mesco, 150-ohm Relay (new)	$2.75
$2.50 Electro Sending Condenser (new)	$1.75
$2.50 Electro Loading Coil (new)	$1.75
$2.00 Omnigraph and 5 dials	$1.25

All the above are in perfect working order and condition. Sent within 24 hours of receipt of order. Address Fred Eckstein, River Road, Hoboken, N. J.

FOR SALE—One-inch Bulldog spark coil, $3; electrolytic interrupter, $1.25; electrolytic detector, 75c.; potentiometer, 50c. Will pay cash for audion. Robt. Sandifer, Eldorado, Kan.

FOR SALE—Sending outfit, consisting of a 2¼-in. coil, navy gap three, condensers, key, and storage battery of 8 volts, 80 amp. hours, for $18; or sold separately. Fred Carlotte, 78 Christopher St., New York, N. Y.

FOR SALE—Four-horsepower motorcycle engine in fine condition with carbureter and spark coil. Has connections for carbureter and oil, and is just the thing for cycle car or air wagon. Price $15. L. E. Beckley, Ukiah, Cal.

I HAVE for sale or exchange 2,000-ohm Brandes 'phone, qt. Leyden jar, $7.50 loose coupler, typewriter Rem. No. 6 in A1 condition, 2-cylinder gasoline engine, 14-horsepower, air cooled, in good running shape, 12-gauge Remington shot gun, pump action, hammerless, as good as new, numerous electrical and mechanical books. All the above is in practical, A1 condition. I will trade for anything electrical or mechanical, or sell very cheap. Don't hesitate to write me, for I have some bargains. I had rather sell the above articles. E. A. Hahn, McNary, Ky.

FOR SALE OR EXCHANGE—One complete sending and receiving wireless set with 2,000-ohm 'phones; will sell at a sacrifice. For full particulars write me. Would also like to buy or swap accessories for O Gauge Electric trains. George Adams, 601 North College, Charlotte, N. C.

MUST SELL—Circumstances force me to sell my ½-k.w. Packard; used two months; $8.50 brings it prepaid. L. A. Walker, 1716 South 20th St., St. Joseph, Mo.

HAVE Excelsior printing press with outfit, camera outfit, Roller organ, postcard projector, wireless apparatus. What have you? Nathaniel Leek, Amagansett, N. Y.

FOR SALE—Brandes Superior 'phones. One 'phone and head band new. Other 'phone in good condition, $3. Arnold's special make loose coupler, primary 12-in. long, fine instrument; can be used three different ways, $7; Murdock $3 variable, $1.50; large cabinet, good mahogany finish; has two tap switches and taps also test detector, $1.50; complete set for $10.65. Edwin Cohan, 601 West 156th St., New York.

FOR SALE—Two tuners, value $7.50; sell for $3.50, or $2 each; $5 Ferron detector, $2.50; $5 Murdock variable condenser, $3; $3 aerial switch, $1.50; $9 cash for whole outfit. All bought new and in good condition. Ellsworth Davis, Morrice, Mich.

WANTED—Second-hand dynamo cheap (110 v., about 10 amp.) or smaller machine; send description. Clarence L. Robinson (Curtis Rte.), Waynesville, Mo.

HAVE telegraph set, step-down transformer, 110 A. C. to 8 D. C., and drawing set; want 2,000-ohm head set. Write. Stephen Kent, 92 Campbell St., Pawtucket, R. I.

FOR SALE—No. 3 Brownie camera in excellent condition with portrait attachment for same; developing and printing outfit with instructions. All for $7. Write. Walter Curnutte, Rivesville, W. Va.

MOTOR WHEEL WANTED—Have up-to-date receiving outfit, complete in every way, including audion, Blitzen variable, Brandes 'phones, commercial loose coupler, etc., 1-k.w. quick-throw aerial switch and 600-volt lightning switch also included; want to exchange for Smith motor wheel in good condition. All inquiries will be answered. Edward J. French, Peekskill, N. Y.

HAVE $12 mail-order course, $5 stamp collection, $3 "Solid Receiver"; want good receiving set, or other wireless instruments. Mort Calcott, East Liverpool, O.

FOR EXCHANGE—Cameras 5x7 Century outfit, 3A Eastman Kodak, Premo Filmplate outfit, pair prism binocular field glasses, a $20 electric postcard projector, Savage automatic self-loading rifle, 22-cal.; two hammerless revolvers, tools, etc.; want electrical goods, open core transformer, or 1-k.w. closed core, a Tesla coil, or what have you? Odell, Optometrist, Fremont, Mich.

FOR SALE OR EXCHANGE—Experimental laboratory equipment consisting of volt meters, galvanometers, Wheatstone bridges, and other electrical instruments, together with large quantity of telephone relays, drops, jacks, transmitters, receivers, magnet wire, granular carbon, carbon electrodes, chemicals, small dynamo, lathe, drill press, filing cabinets and other equipment. State what you want. H. R. Van Deventer, Box 591, Sumter, S. C.

FOR SALE CHEAP—Complete amateur station, sending and receiving set, and large aerial; will sell for $15; worth twice as much. If interested, write. Ed. Guilmette, 343 Mason St., Woonsocket, R. I.

FOR SALE OR EXCHANGE—Complete volumes of Popular Electric magazines, Nos. 2, 3, 4, 5, 6; make reasonable offer; all ready for binding. William Kirsch, 782 Bergen St., Newark, N. J.

POWERFUL 11-in. water motor, $4.25; $15 Erector outfit with $3 motor, $8; 22 rifle, $1.75, cost $4.50; will exchange for audion bulb, 3,000-ohm 'phones, Multi-Audi-Fone and aerial. Archie King, North St., LeRoy, N. Y.

COMPLETE "Talking Head" for the construction of a telegraphone, will be exchanged for any of the following instruments: A hot wire ammeter, Weston or Keystone voltmeter, small dynamo, opera glasses, variable condenser, or what have you? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

Opportunity Exchange

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.
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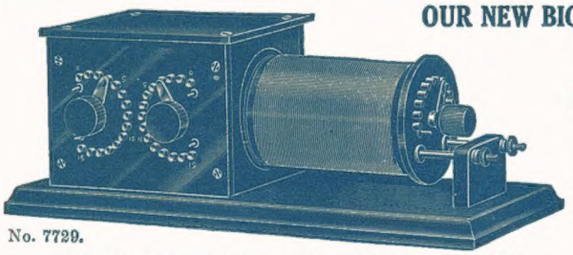

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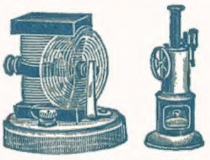

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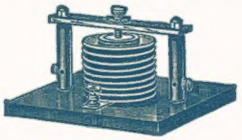

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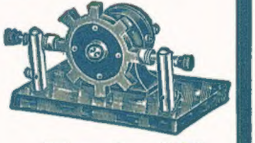

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